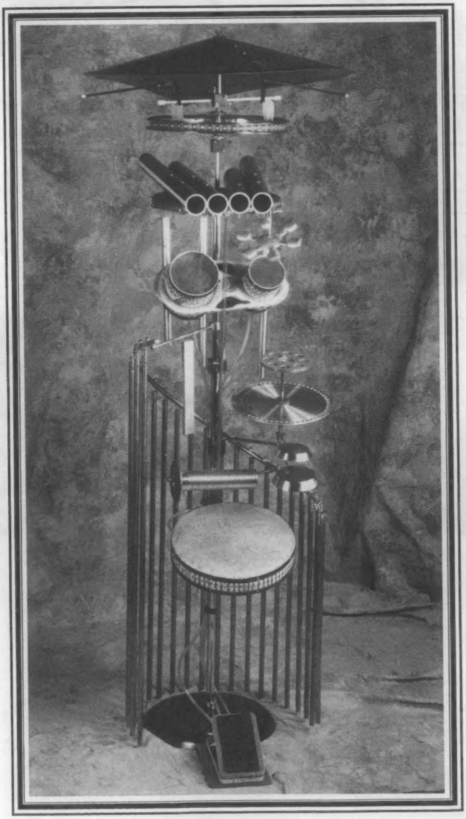
VOLUME 11 #2 DECEMBER 1995 PRICE $6

EXPERIMENTAL MUSICAL INSTRUMENTS

For the Design, Construction, and Enjoyment of Unusual Sound Sources



THE SINGLE STRING

Historically speaking, a central element in the development of scientific method has been the effort to find ways to describe the physical world in mathematical terms. In recent centuries, arts and sciences have tended to move in separate spheres. Yet among humanity's earliest attempts to apply number to the physical world, *musical* investigations were of primary importance. To facilitate the study of musical pitch, ancient investigators created one of the very first of scientific instruments. This is the instrument, now 2500 years old and more, still known today as the *monochord*. In this issue of *Experimental Musical Instruments* you'll find a contemporary look at this very old instrument, complete with a brief history, construction basics, and notes on its use.

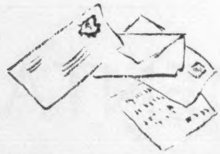
Also in this issue we have a photographic essay on the strange and beautiful ceramic flutes and whistles of Susan Rawcliffe. There are drums that are more than drums from Ken Lovelett (see the photograph on this page), and a tour of the remarkable instrument collection gathered by Albert Leskowsky in Kecskemét, Hungary. The first in what we hope will be an ongoing series on historical musical instrument patents is in this issue as well, along with the mystifying natural history of the Sky Harp, as reported by Reed Ghazala ... and, as always, much more. So open now, and read.

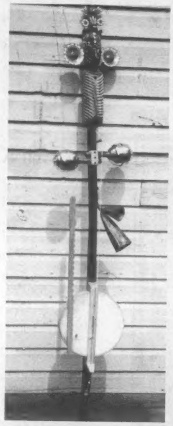
Photo: The Busker, created by Ken Lovelett. See the article beginning on page 14.

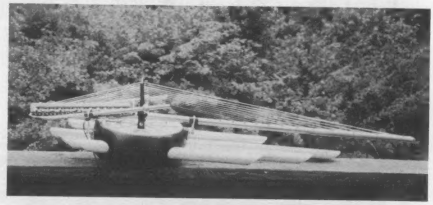
I'VE BEEN TRYING to not write for the longest time, but you've finally worn away my resistance. When you requested dream instruments I didn't send you my dream Chaise-lounger-Harp, wherein the strings go across the beach chair part upon which the player lies down, and continue upward towards a movable hinged soundbox, creating something of a musician sandwich. The player's large body movements on the stringed bed vary the tension on the played portion overhead thus creating an interactive microtonal variable-pitched harp-lounger. I didn't send you my dream bassoon made from a hollow tree branch played with the fingers and the toes over open holes. I didn't send you photos of my six-hole Horse Conch which with some lip training has over an octave diatonic range (see photo). Note scale fingerings (diagram below), epoxied brass ring on ground end to create a mouthpiece, epoxied brass rod bent to match shell edge to prevent chipping. I didn't send you photos of my own "Bob's a BumBass" (see photo- incomplete awaiting temple blocks and sleigh bells) inspired by your great historical series on same. Some improvements: Beater rattles over screw-eye guides — add small-gage clear plastic tubing (model airplane fuel line or aquarium air tubing) to silence; also metal string rattles in beater — use weedwacker line looped around beater eye to reduce wear. I have yet to decide if the actual sound of this instrument warrants these efforts! What finally broke me down was your recent article on the Stroh instruments. Nice work. I've never heard of them before, but had just been working on an acoustic attachment to my Gravikord® (See *EMI* Vol III no.6 April 1988) using Dobro® parts and bridge sisters, as the tension on the Gravikord would by itself collapse the Dobro aluminum cone (see photos). I was making essentially a Stroh Gravikord! It's great to be working on the cutting edge of last century's technology. Keep up the good work.

Also, Pip and I had an article published in the Spring '95 issue of the *Folk Harp Journal* "St. John Serendipity: Travels with the Gravikord." Some of your readers might be interested in where an audience-friendly new instrument can take them.

Robert Grawi







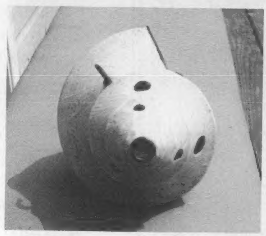
SOME OF THE INSTRUMENTS mentioned in the letter at left from Bob Grawi, maker of the kora-like instrument called *Gravikord.*

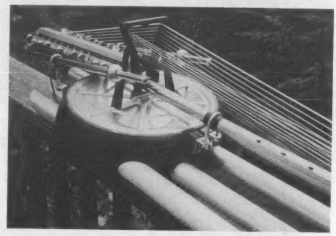
Upper left: Bob's a Bumbass

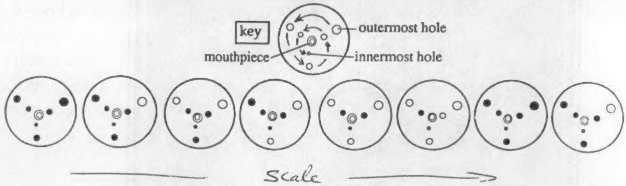
Lower left: Six-Hole Horse Conch. A diagram showing the fingerings appears at the bottom of the page.

Upper right: Grawikord® with dobro® cone resonator.

Lower right: Detail of the Dobro Gravikord





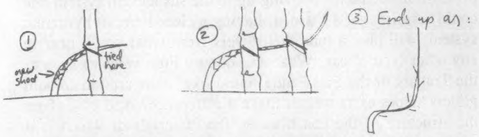


IT SEEMS THAT with every issue I read there are opportunities to write letters adding information to various articles, or just making comments. In this issue I could add (as could others, I suspect) extra titles/discography to René van Peer's article [on commercially available nature sound recordings, appearing as a three-part series in EMI's last two issues]. He bemoans the lack of 'one long take' CDs of environmental sounds. Here, in Australia, several people/companies have released materials in just this format. The Natural Symphonies label (Werombi Rd. Camden NSW, 2570 Australia, Fax: (046) 512 648) has two CDs by Melbourne sound artist/composer Les

Gilbert. *Kakadu Billabong* is a 78-minute take starting at 6:40 AM at Nourlangle Creek Billabong in Kakadu National Park in Northern Australia. The other CD features three 25-minute takes of three different forest environments. A few years ago (1990), the Shire of Eltham (just outside of Melbourne) released a cassette recorded by Duncan King-Smith of bird and bush sounds. One side is a 20-minute take of a lyre-bird in absolutely brilliant vocal flight. (Cassette title: *Bird Songs and Night Calls*). These are three titles; there are quite a few more

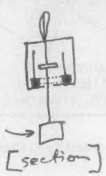
I've been enjoying Richard Waters' articles on bamboo cultivation, etc. I've also gone back to earlier articles in *EMI* on bamboo and its musical usage and my own 1989 article ["The Bamboo Orchestra" in EMI Vol V #1]. Here, in Melbourne, it's quite easy to obtain bamboo from other people's gardens without growing it yourself. Most of the nurseries here sell monopoidal (running) bamboo, and in our climate, boy, does it run. I had some thin black bamboo in a pot that was beginning to look rather sickly, so I put it into the ground saying to myself, "Yes, I'll control its spread." Well, within a few seasons it had shot up to a magnificent height, and the rhizomes had gone everywhere!! Not wanting to foot the bill for replacing my neighbors' water and/or sewer pipes etc., I had to poison it and cut it down and dig out as much of the roots as I could. There was a lot! Now, five years later, I'm still using the fine straight poles in various of my installations.

I also *made* myself a few beautiful "bent" bits. One often sees culms that have grown "around" something, and their out-of-the-ordinary status makes them intriguing and eye-catching. My experiments in tying down new shoots with string to older well-established culms successfully resulted in elegant curves.



And I still keep collecting the "odd" bits I see. I've found that even the Botanical Gardens will cut the bit down for you (maybe a year later) if you explain who you are and what it's for. A Japanese woodworker I know told me bamboo can be bent by steaming, cutting, etc., but he said to me that it's probably far more "Zen" to find a good bit with good bends and incorporate its use by exercising your own flexibility of design, etc.

Now, at last, I can get to the main event — Bart Hopkin's article on toys and their mechanisms [in *EMI*'s last issue, Vol 11 #1]. You've only just touched the surface. Ask anybody who deals with percussion and they'll show you their collection of toys that make good sounds, etc. Your closing paragraphs on p. 13 dealt with a "magic" rattle of steel rods on a base inside a resonator case. This device comes in various guises — the rattle with handle as you found, the weighted toppling clown with hemispherical base, the cloth and foam covered colored soft cube, the Fijian "tourist-toy" bell (tines inside bell {wooden box} with wind sail on string connected to beater[see the drawing on left]), but best of all is the Fisher Price ® *Happy Apple*. As can be seen from the photo, happy it certainly is. It's about 5" in height, made of *very* solid plastic, has a very good sound quality, is very responsive to manual



IN THIS ISSUE

EXPERIMENTAL MUSICAL INSTRUMENTS
For the Design, Construction and Enjoyment of Unusual Musical Sound Makers

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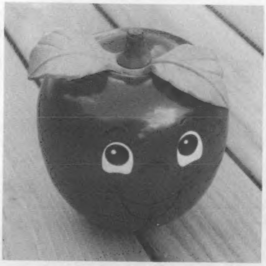
SUBMISSIONS: Experimental Musical Instruments welcomes submissions of articles relating to new or unusual musical instruments. A query letter or phone call is suggested before sending articles.



The Happy Apple

playing, fits snugly into the adult hand, can be suspended by tying string around the lever and stalk, can be thrown from player to player, rolled on the floor, and a number of other different playing "extended techniques" ingeniously devised. It's great — Adam and Eve never had it so good. Availability may be the only problem. I've had mine since 1982 after it had been a favorite toy of two children (with no appreciable signs of wear). Someone else recently looked for one and was told that they're not made any more. Mine has a code-line on its base: Fisher Price Toys Pat. Pend. Made in USA 435 © '72. Fisher-Price make a number of other good 'n' solid musical toys, including an "infant's activity center" of bells, springs and ratchets on a flat and recessed plastic board that can be attached to pram, playpen or highchair. This device has been used as the "sound palette" for pieces by more than one Australian experimental music composer. The Happy Apple features as the melody line in "Happy Apple" — track 17 on Side B of my 1992 independent cassette *Thirty More.*

Kind regards — until next time.

Ernie Althoff
9 Stanhope Street, Armadale Victoria 3143 Australia

THE FREEWAY GROOVE

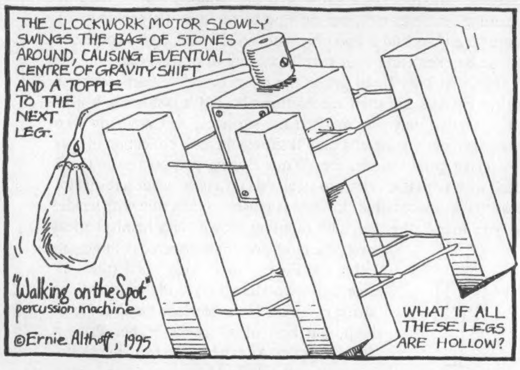
When returning to Holland from a holiday with my in-laws in Hungary this summer I drove with my wife and kid along the German freeways. As always we passed two stretches of road that reminded me I should write about them for *EMI*. This time I was prompted even more strongly, as Mike Hovancsek had touched on this phenomenon in his article about Speed Bump Music [in *EMI* Volume 10 #4].

We had started our journey the day before late in the afternoon and had been driving throughout the night, only taking short naps when off the wheel. Now it was around 7 AM. Having passed Koblenz on the Rhine we were driving along the freeway in northwesterly direction towards Monchengladbach and the Dutch border. My consciousness was in a split condition. On one level I was concentrating on the road and the cars around me; on another level my thoughts wandered freely, jumping sliding and somersaulting of their own accord. On yet another I was monitoring these separate activities with some amusement; and then towering over all these was a constant wariness, a speck of awareness focused on one thing — surveying my concentration on the road. It was the state of lucidity the mind also reaches when jet lag works as an energizer.

Suddenly the car filled with a rich polytonal but rather indefinite sound texture, as if a female choir were humming harmonics with open voices and a lot of air flow. The tones seemed to shift continually, as did the tonal center. There was no sense of physical depth to it, no stereo. It just filled the cabin of the car, but filled it entirely. Due to lack of sleep the music was even more evocative than on earlier occasions. Immersed in the shimmering, shifting flow of near-vocals I started wondering about questions relating to this sound transmission system. I had already noticed on earlier trips that the humming appears when the road has shallow lengthwise grooves. Whether their presence is a matter of design or erosion, is hard to say. I noticed them in both tarmac and concrete. Evidently it must be the movement of the tires over the corrugated surface which starts the vibrations that ultimately suffuse the interior of the car. In principle the system is similar to that of old record players — friction causing vibrations that are amplified acoustically. There are, however, differences.

First of all, the automobile (save for the horn) was not conceived for the purpose of sound pick-up and emission. On the other hand, especially in the case of the more luxurious models, designers attempt to make the entire system relatively silent; inside, at least. Noise of the engine as well as of the tires is dampened. The more expensive the vehicle, the less chance there is that the roar of the motor drowns out the hum. But then one may wonder if the vibrations of tires and suspension will not muffle the road's wail, too. Therefore, it is imaginable that an optimum type of automobile exists.

Another question is how the tires influence the structure of the sound. Is there a difference between those with and without tubes, between various types of profile and its condition, between wide and narrow wheels? What is the role of air pressure inside them? Moving up to the suspension system one could surmise that a Citroen, having a closed-circuit hydraulic system, will play a tune that differs from what you'll hear in any other type of car. What will bumpy little vehicles such as the Trabant or the Fiat Panda sound like, compared to smooth gliders? Does extra weight make a difference? And how about the structure of the coach-work, the materials of which it is made and their solidity? I think it is hardly likely that a stereophonic effect will occur. That would require the left and right part of the cabin to be separated, so that both halves can



Walking on the Spot is part of a series of possible sound devices drawn by Australian sound artist Ernie Althoff.

vibrate independently. The current cage construction seems to distribute the resonances evenly over the entire shell. This would at least account for the diffuse nature of the sound.

The question whether the speed of the car affects pitch is not as easy to answer as would seem. When everybody around you is driving at 90mph, it is not advisable to drive at half that speed in order to carry out an experiment to solve it. At a certain point, however, a speed limit road sign had been put up saying, "Grooves. 80km/h".. So everybody obediently slowed down to the prescribed velocity. It is hard to tell whether my fantasy played tricks upon me, but it seemed as though the sound texture became even more luscious, more complex, stronger. The entire car was a-hum with cascading chords. The questions that had been hovering about in my mind were at once chased away by new ones. Was this speed limit exacted so as not to damage the road any further, or because driving faster on this surface might be hazardous for one reason or other? Or could it be, could it just be, that it was the sincere intent of the German authorities (or someone within that power maze) to draw drivers' attention to this phenomenon? I know that it sounds highly unlikely; but then, who knows what a bored civil servant with a bent for the bizarre might get up to?

The surface of the road must also be instrumental in this whole process. Not all grooves result in such exquisite sounds. Recently I came along some stretches of Dutch highways that were being prepared for road works. For that purpose the top layer had been sliced off. I heard nothing but a rather dull uniform rumble. The relation between road surface grain and sonic effect still needs serious scrutiny.

As for aesthetics, contributions in *EMI* mentioned bridges "performing" pop songs, roads reciting geographically appropriate lines. Maybe people will marvel where the sound comes from, when driving along those stretches. I do not find that idea exciting, really. Sonic intrusion (whether devised for the purpose or as a by-product of human activity) is on the increase; design seems to follow one's every step. I would experience such intentionally shaped acoustic wonders, however cleverly done, as being controlled by an untouchable human power. What I like about the sounds as generated by these parts of the German freeway system, is that they are so undefined. You never know whether you hear exactly the same every time you are moving there. Each time it sounds as familiar as it sounds new to the ear. It is still worthwhile to try and follow all the complexities of this intangible texture, even after so many journeys there and back on these roads.

René van Peer
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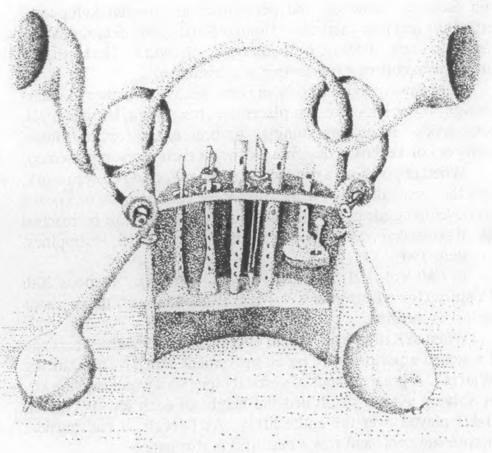
... AND SPEAKING OF that dandy rotary rasp [described in last issue's "Ramblings" column]:

I once carved a series of equally spaced rows of notches around a rolling pin, lopped off the handles and rigged it to be turned by the treadle mechanism of an old Singer sewing machine. I played it with the corner of 4" by 4" squares of veneer which could be flexed at the other corners as the notches whirred against the playing edge. This flexing would modulate the tone quality considerably, giving the overall strident sound a strange vocal quality. Unfortunately it also had a noisy quality — the result of the veneer dragging across the surface of the rolling pin in between the notches. The rotary rasp's mat ridges seem like a much better



Drawing by Robin Goodfellow

solution.

Without a suitable flywheel, maintaining a constant speed was very difficult. But the resulting somewhat wobbly sound seemed to fit with its vocal nature. Accompanying this was the soft rumbling of the treadle mechanism whose cast iron framework, appropriately enough, was boldly emblazoned with the logo, SINGER.

All in all, I'd say it filled a very, very small musical niche. The scale was diatonic in Just Intonation — a fairly easy scale to figure out given the small whole number relationship of the intervals. To figure the lowest whole number of notches or ridges necessary in any scale based on ratios, simply view the ratios as fractions and find the lowest common denominator — that's your 1:1.

Ratios:	1:1	9:8	5:4	4:3	3:2	5:3	15:8	2:1
Equally spaced notches	24	27	30	32	36	40	45	48

Another possible solution for accommodating fractional numbers of ridges: If, as in the example given, you need 56 ¼" ridges, why not size the disk to accommodate the fraction but simply leave the ridge itself out? If the ridges were 1/8" apart, you would end up with one space 1/8 x 1/4 wider, or 5/32" instead of 1/8". I suppose this method would shift the phase of the vibration cycle once every revolution, and so might not be desirable. On the other hand, it might make the sound even more obnoxious!

Michael Meadows

AFTER A LONG BUT NECESSARY HIATUS leading to retirement, *Wake the Marimba* [a book being compiled by letter writer Blake Mitchell] is again at full throttle.

24 of the 32 chapters are now finished (except for some sketches). And there is still a lot of correspondence with contributors; among whom are Del Roper, marimba builder, innovator and inventor; Chris Banta of bass and sub-bass marimba fame;

Ed Saindon, teacher, and performer on grouped xylophone, marimba and bass marimba; Thomas Reed of *Musical 6-6 Newsletter* and now of *Music Notation News*; Edwin L. Gerhardt, bar instrument collector, performer and historian.

I hope many more who have been creative; whether in mallet design, frame structure, bar placement, bar design, bar materials, suspension, resonators, tuning, timbrel expansion, mirlitons, dampers or keyboard design...will want their work represented.

Whether you head a production company, or do custom work, whether you build just one instrument for your own use or a dozen in developing ideas, I'd like to hear from you. I can be reached at: Magbagakay, St. Bernard, Southern Leyte 6616, Philippines.

Item Two:

In *EMI* Vol. VII, Kenneth Peacock writes on "Famous 20th Century Color Instruments." There is another such that perhaps deserves mention.

When in Kailua-Kona island of Hawaii about twelve years ago I watched a performance on an instrument called "The Dancing Waters". A great number of vertical pipes shot water into the air. A valving system controlled the height of each jet, as colored lights played over the entire array. As I recall, it had musical accompaniment, and was a beautiful performance.

Item Three:

EMI has presented numerous articles on bamboo and its musical uses. While not strictly musical, I think this might interest those who put on "dangerous performances"

Here in the Philippines at Christmas, boys make what they call *Luthang* to celebrate with noisily. I call them "Bamboom".

They cut a shaft of bamboo from three to six feet long, usually from four to six inches diameter. They ream the bore, leaving a node to close it at one end. A few inches from this node they bore a touch-hole a half inch in diameter.

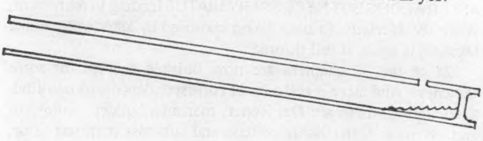
The open end is tilted up about twenty degrees, so a cupful of kerosene poured into the barrel puddles under the touch-hole.

A small torch soaked with kerosene held near the touch-hole ignites the puddle, which explodes out the muzzle with a long tongue of flame and a fearsome roar! The explosion kills ignition, the operator blows out the smoke and can fire again every few seconds until the kerosene puddle is exhausted.

The shorter the tube, the more of a "crack" the explosion will have as a starting transient. Barrel length has no detectable effect on pitch, since the action is an explosion rather than a tone. Singed hair and eyebrows are occupational hazards.

When you have 20 to 50 Bambooms in steady use, it sounds less like Christmas than a war zone. Talk about a Soundscape!!

Here is a sketch of the Philippine rural substitute for firecrackers. Let's see now .... a four inch water pipe with an end cap screwed onto it...Ah yes!



I just read through my entire collection of *EMI*. Thanks to all who are teaching me so much!

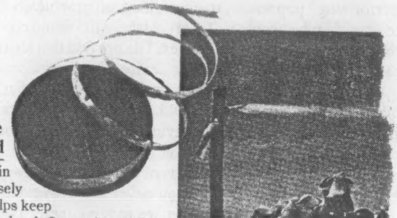
Blake Mitchell

Magbagakay, St. Bernard, Southern Leyte 6616, Philippines

NOTES FROM HERE AND THERE

SOMEONE SENT THE ITEM SHOWN BELOW, clipped from the Brookstone catalog (1-800-926-7000) — we don't know who, because in our normally highly organized office the clipping got separated from the sender's envelope. A note was clipped to the item reading "Do you suppose this is related to the telephone wire vibrating phenomena?"

... Yes, this bird scarer tape does seem to be another example, along with singing telegraph wires and smaller aeolian harps, of strings set in motion by the wind. Some makers of unorthodox wind-sounded string instruments have discovered that flat bands, such as the tape shown here, are more responsive to wind currents than are round wires, being more readily excited and producing a louder and much coarser sound. But apparently this tape primarily generates frequencies that are, from a human point of view, ultra-sonic, with (the buyer might hope) not too much noise in the human hearing range. Why there should be a high frequency emphasis with this particular tape may have something to do with its thin-ness; or perhaps something to do with torsional modes of vibration, or ... um ... um ...



Chase Away Destructive Birds With Ultrasound

You can't hear it, but our ultrasonic tape vibrates in the breeze, producing a harmless, but intensely aggravating (to birds) sonic barrier. Helps keep destructive birds away from your garden, lawn or orchard. Comes in *100 ft.* spools, cut to size as needed. Reusable year after year.

109819 Bird discourager tape $11.00

Two or more, Each $10.00

IN RESPONSE TO the description of the instrument called the rotary rasp in the editor's "Ramblings" column in *EMI*'s last issue, our regular contributor Reed Ghazala sent photocopies of several pages from the book *Sound and Music* by J.A. Zahm, published by A.C. McClurg & Co. in Chicago, 1892. This wonderful book, cited previously by Reed in a couple of his *EMI* articles, is full of fascinating descriptions and engravings of mechanical devices for the exploration of they physics of sound.

The two apparatus shown here (next page), unlike the rotary rasp, are wind instruments, As realized in Fig. 167, the idea is: an air pipe directs a stream of air against the wavy edge of one of the rotating rings. The serrations of the edge rise and fall in front of the air stream, blocking and un-blocking it in a periodic

fashion. If the rings rotate at sufficient speed, the frequency of this blocking and un-blocking falls in the hearing range, and people present will actually hear a tone. The tone will correspond to the frequency with which the serrations pass in front of the air stream and, in theory, to the waveform of the serrations. The presence of three rings, each with two serrated edges to choose from, and six suitably aimed air pipes, means that the apparatus can produce six different frequencies and/or wave forms. The second picture (Figure 168) shows a more sophisticated realization of the same idea, with 16 wavy-edged disks replacing the rings.

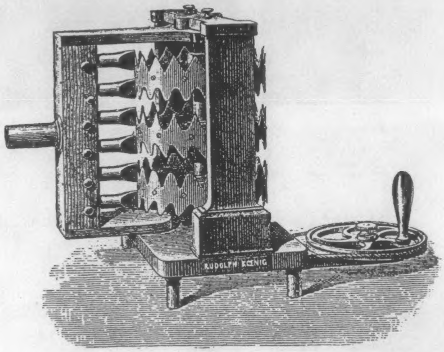


FIG. 167.

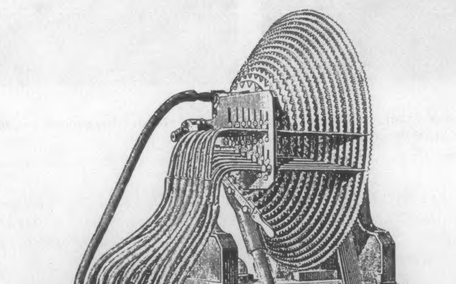


FIG. 168.

Engravings from *Sound and Music* by J.A. Zahm (A.C. McClurg & Co., Chicago, 1892)

At first glance these devices seem to be very similar in concept to simple sirens such as that described by Helmholtz early on in his *On the Sensations of Tone* (published a few years before Zahm). Helmholtz' siren consists of a rotating disk with one or more concentric rings of holes in it. The disk rotates directly in front of an air stream from an air pipe. The air comes through the holes in discrete puffs — one puff each time a hole passes in front of the pipe. Thus the rotating perforated disk converts a steady air stream into a series of puffs, producing an audible tone at some number of puffs per second. With the Zahm drawings, however, it's not clear that the wavy edges of the disk or ring are actually blocking the air stream, since the air pipes don't appear to be close enough to the disk actually stop the flow. It may be that the intent, instead, is to for a sounding effect resulting from the periodic reflection or turbulence of the narrow air stream striking the rising and falling edge.

Who will be the one to recreate these instruments? You can think about that ... in the meantime, it is my hope that we'll be having an article in *EMI* on simple sirens before too long.

MORE NATURE ON RECORD NEXT TIME: The third installment of René van Peer's three-part series "Nature on Record," which was originally scheduled to appear in this issue, will be delayed until the next. The series is both a survey of available nature sound recordings and an essay on related aesthetic and philosophical issues. The delay will allow the inclusion of at least one important new release, and a bit more research into some of the areas under consideration.

EMI NOW HAS A SITE on the World Wide Web. Check it out at http://www.thecombine.com/emi. The site is designed primarily to introduce people to the journal. But even those already familiar with us will find some things of interest, including reprints of several articles from past issues, and, coming soon, a subject index covering *EMI*'s first 10 years of publication. Web site architecture is by Malcolm Kwan of The Combine.

Speaking of being hooked up, remember that you can now reach us by e-mail at ExpMusInst@aol.com.

CORRECTIONS

The address given on page 24 of *EMI*'s last issue for Wild Sanctuary, a source for nature sound recordings, has changed. The new address is 13012 Henno Rd., Glen Ellen, CA 95442.

Also in *EMI*'s last issue we made reference to David Shucavage's instruments-friendly site on the World Wide Web but gave the address incorrectly. The correct address is http://www.lm.com/~dshu/folkstuff.html.

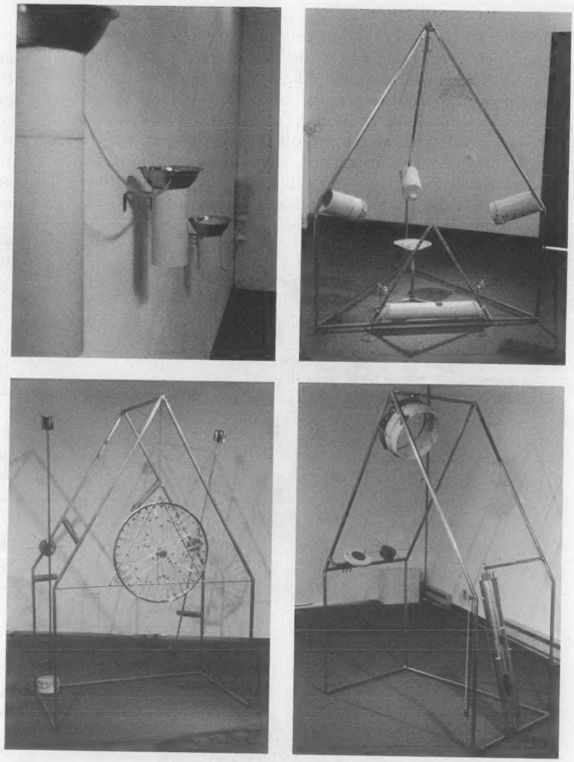
JAMES COURY recently presented a sound installation as his senior thesis at Evergreen State College in Washington. *EMI* asked him to send along some notes and photographs on the exhibit, and he responded:

The show, called "Yes Plan," can be described as a room of interactive sound sculptures, a random music installation, or a sonic exploratorium.

The first of four pieces begins in silence as you trip its motion sensor. A hidden pump circulates, and drips water from the ceiling to plastic membranes over PVC tubing, creating random, shifting rhythms, which vary in timing and timbre. The second piece, which brings in the hands-on interaction, is also triggered by motion, plucking its three piano strings, resonated by PVC and skin, like some entranced robot, and you are drawn inside to sit and accompany this drone with your own dual, fretted (movable), foot-pedal-plucked notes.

Simultaneously, across the room, a windy flute sound builds and begins to change, as a thin stream of secret air blows across glass tubes of various lengths, mounted on a bicycle wheel, creating an accelerating pattern of panpipe joy. Behind this are large balanced arms with the word "spin" printed on them. Their slow, near-perpetual motion plucks steel rods, clicks through notched bamboo, and slides across goatskin head, making a strange, mad-scientist carnival of movement and sound.

The fourth piece still sits quietly, waiting for your involvement. As you turn the crank, a hurdy-gurdy-like action vibrates the string and large drumhead into a deep frenzy, while another arm rotates and strikes rods, and you do this for a very long time. On your other hand there is a crank and the word "bow." As you do, a revolving pattern of bowed zither sounds are added into the brew.



Four Installations from James Coury's show "Yes Plan," shown in the sequence in which they appear in the description at left.

This is my statement:

sound
first experience
remember
mom singing, who says she can't sing
bedroom gurgling rain gutter
bothersome noises become interesting collages
comb and wax paper
listening
plugged ears hear body
sound realigns stray molecules
head on sand
footsteps and crabs
train and ocean
open reception of all sounds
crowds of people whisper
secret songs
humming wires
releases stored information
natural communication
silence
last sound
octaves of vibration
toning breath

this work is for playing   this play is for learning   this learning is for living   my ideas grew into their own forms   these forms evoked new ideas   I'm not sure what I've made   but when I listen I hear myself   I want everyone to hear themselves   it is all the same

I experienced much joy watching people wondering and discovering, running around like children, playing and laughing. This is mostly why I do this work. I feel this open state of listening/playing is a major key in the waking up we are doing. Even the purely physical effects of sound alone are enough to, for example, loosen old patterns of thinking and doing, and free up creative energy. Together, as it must be, with the emotional, mental, and spiritual nature of the experience, it is one pure dose of life. Yes, I am hooked. I am in a life of sound, of making, of playing, of listening, and of sharing. I am in love.

"I am most interested in this connection thing," James adds, "so call or write if you want to collaborate, play, trade, or just talk.".

— *James Coury,*
903 Rogers nw #1, Olympia, WA 98502;
(360)943-3984; couryj@elwha.evergreen.edu

THE FLUTES AND SOUND SCULPTURES of SUSAN RAWCLIFFE

Photographs by Gene Ogami

Text by Susan Rawcliffe

Ten years ago, in the December 1985 issue of Experimental Musical Instruments, *we first featured the extraordinary flutes, whistles and ocarinas of ceramist Susan Rawcliffe. More recently, in the December, 1992 issue, Susan described her research on flutes and whistles in pre-conquest Mesoamerica, in an article titled "Complex Acoustics in Pre-Columbian Flute Systems"* (EMI Vol. VIII #2). *Here now is an update on Susan's instruments as they have continued to develop in the intervening years.*

Photo #1, this page

THREE-PERSON WHISTLE

1995, Ceramic, 12 1/2" X 14" dia.

Light green engobe with colored splotches, clear glaze and gold. (Engobes are clay slips in a wide range of colors. I often add splotches of additional colors with oxides. By using patches of glaze, my pieces have smooth, shiny areas mixed with the dull textured clay surfaces of the engobes.) The little balls on the bottom of this piece are the whistles: there are two for each of three players. I am fascinated by the concept of placing performers in intimate and unusual juxtapositions. Each whistle has one fingerhole, and all six are tuned to play together. By placing the players in close contact, the effect of the combination tones generated by the high-pitched whistles is intensified. After observing reactions to my space flutes and to my sets of such single whistles for play by small groups of people, I find that standard experiences of combination tones include: a sense that sound is physically moving the ear drum; an impression that the sounds seem to move through the head from ear to ear; a feeling that the sounds are generated inside the head; and, in small groups, the sensation among the players that they do not know who is playing which sounds.

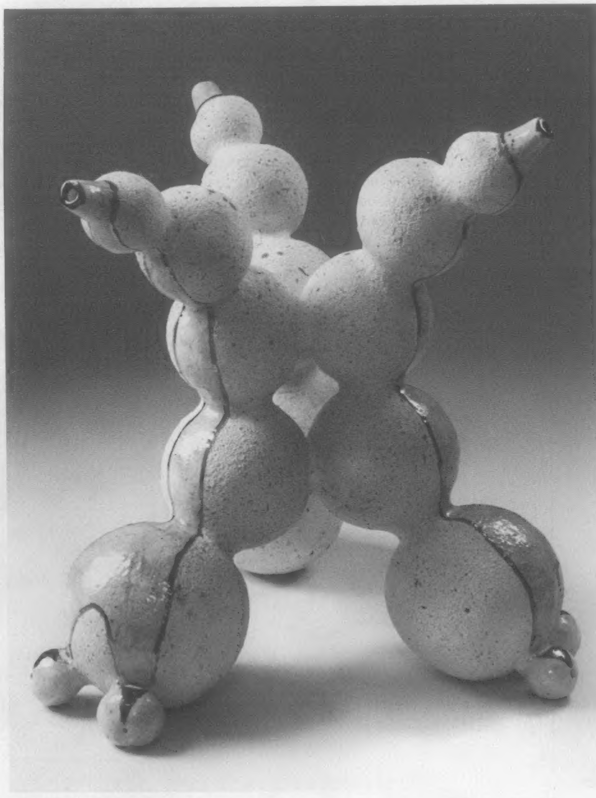
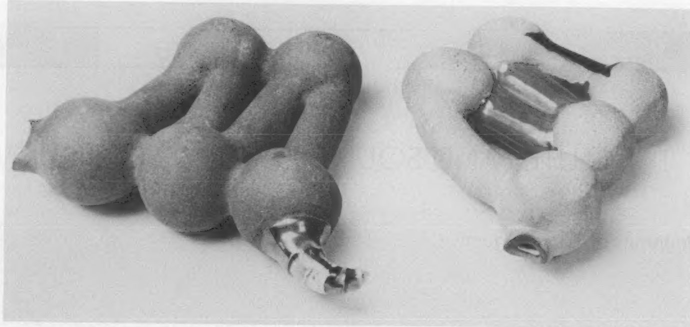


Photo #2, right



BALL & TUBE FLUTES

1989 Ceramic
1 1/2" X 6" X 5 3/4".

Decorated with engobes and glazes; four fingerholes each. The ancient examples of these flutes as discussed in my article "Complex Acoustics in Pre-Columbian Flute Systems" (EMI Vol. VIII #2, pg. 10) generally consist of two balls joined by one open tube. I extended the design by making 4 balls with 3 tubes or, as shown here, 5 balls with 4 tubes. This makes a small compact flute that can play unexpectedly low tones. Because of its irregular shape it plays irregular overtones. Thus, the scale can not be precisely controlled and each flute seems to have its own built-in melody. They have a haunting, intimate, thoroughly lovely sound.

Photo #3, below

WATER FLUTES 1993 Ceramic 6-7" high X 22-23" long.

Decorated with various colors of engobes and glazes. I also make these flutes in a smaller version: approx. 5" high by 14" long. These flutes are another example of my process of evolving and adapting a pre-Columbian concept such as the ball and tube flute. Adding water was an inspired thought. In play, the performer tilts the flute from side to side. Water moving inside the flute effectively changes the length and volume of the instrument and thus the pitch. Because the resulting movement of the water is partly random, the sound does not always change in predictable ways. The performer sets the mood of the flute by controlling the air pressure to determine the partial that is played, and by controlling the amount of physical movement, which determines the activity level of the resultant sounds. In general this flute has a mind of its own and is truly interactive. Because of the nature of the physical movement required by the player, a performance becomes almost a dance. It is great fun to play and to watch being played.

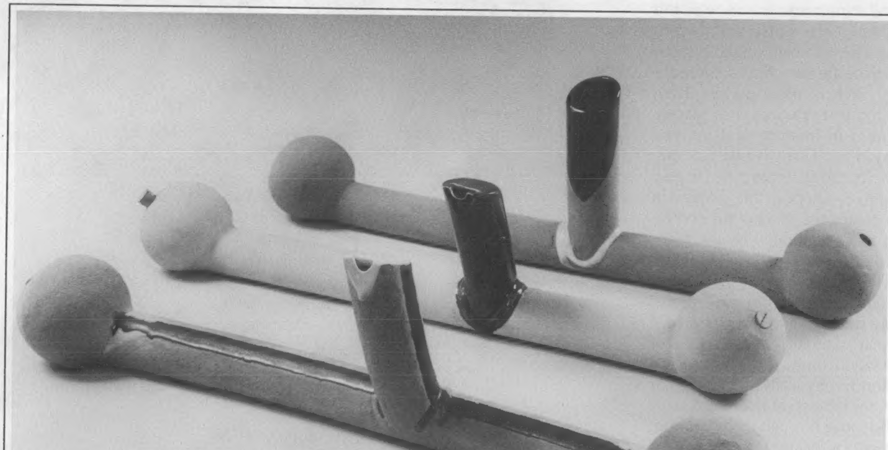


Photo #4, left

FLUTE PILE

1994 6" X 6" X 6"

Beige engobe with splotches of color and glaze. Seven ocarinas tuned to play together. Each is tuned to play a chromatic scale over a range of a ninth with perfect 5th & 4ths, using an ocarina fingering pattern that I developed. There are six fingerholes. The diatonic scale requires two crossfingerings; with no crossfingerings, a pentatonic scale is played. The more crossfingerings required, the greater the scale as tuned is compromised. The ocarina is greatly affected by air pressure changes. I developed this fingering pattern for my pitched necklace ocarinas. See my article *op. cit*. pgs. 8-9 for a discussion of vessel flutes.

Photo #5, right

SEE BEASTIE

1994 Ceramic 9" X 16½" X 7"

Dark gray engobe with colored splotches and tortoise shell glaze stripe. In this two-person instrument, the players cannot actually see each other while blowing. Each blowing end contains a chamberduct flute, with the exit tube adapted to play sideways. This type of flute produces sounds which range from soft and airy, to rich and reedy, to extremely raucous. Please see my article op. cit. pgs. 11-13 for a thorough discussion of the acoustical innards of the chamberduct flute as found exclusively in the pre-Colombian organology. The *EMI* cassette #VIII includes the sounds of two different such flutes.

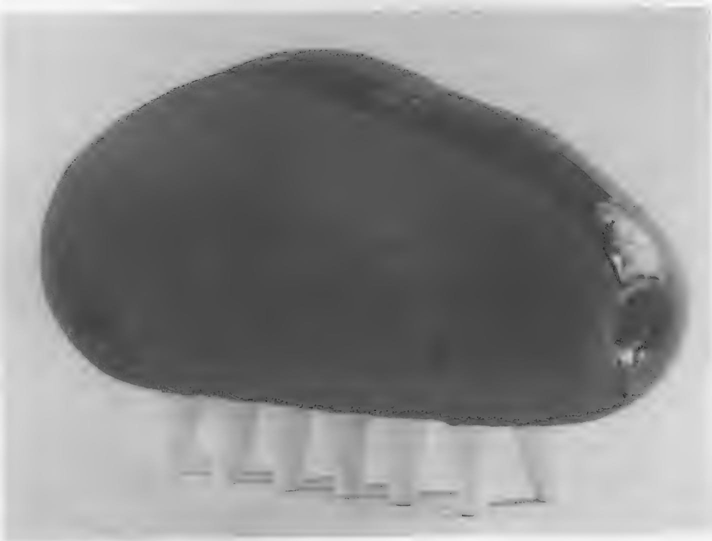


Photo #6, above

WHIFFLES 1992 Ceramic 6 1/2" X 2 1/2" dia.; 8 1/2" X 3 1/2" dia.

Decorated with various colors of engobes and glazes. The lower chamber is an ocarina with five fingerholes tuned to play a chromatic scale over an octave using my standard ocarina fingering pattern. The upper chamber is an open tube placed around the mouthpiece. The instrument is held sideways; the player blows through the small tube protruding from the side. One hand fingers the holes while the other slides the large tube open and shut. Through the interaction of the two chambers, a wide range of wonderful vocal sounds and animal and bird cries can be produced. In play, it feels as if two different types of flutes are joined, with the sound coming out one side or the other. See my article, op. cit. pg. 11 for a discussion of the pitch jump whistles. A sample of whiffle music is also included on the *EMI* cassette.

Photo #7, right

SPACE FLUTES

1990-1995 Ceramic

The sounding tubes vary in length from about 4" to about 6". Decorated with various colors of engobes and glazes. The melody of these flutes is created by the production of strong combination tones. Combination tones are created when the sounds of the two pipes interact in our ears. I currently tune them to play perfect consonant intervals as well as thoroughly out ones. One pipe in each flute has three larger fingerholes; the other four very small holes. These sounds are difficult to record and play back with any fidelity.

Photo #8, right

POLYGLOBULAR TRUMPET

1994 Ceramic 22" x 6" dia.

Dark brown with white terra sigillatas, glaze and gold trim. The design is inspired by drawings as found in Izikowitz, *Musical Instruments of the South American Indians* (originally published 1934; republished in 1970 by S.R. Publishers; drawings on pages 222 and 240). A powerful, breathy, altogether wonderful sound. A listener called the instrument a "female didjeridu," which delighted me. Trumpet-type instruments are a new departure for me, an outgrowth of my years of work with the didjeridu.

Photo #9, below

RACK OF FLUTES

Varied dates and sizes; ceramic, wood, nylon.

Decorated with engobes, underglazes, glazes and ceramic pencils. A small selection of my flutes from over the years, including double & triple pipes, hooded pipes, end-blown and transverse flutes, one harmonic flute, and flutes with pre-Columbian, sub-harmonic and diatonic scales. See my article, *op.cit.* pg. 9-10 for a discussion of tubular flutes. The *EMI* cassette includes the music of a hooded pipe and a triple pipe.

For additional information about Susan Rawcliffe's instruments and sound sculptures, or for information about concerts, lectures and/or workshops, please contact her at P.O.B. 924, San Pedro, CA 90733-0924; phone (310) 547-2043.

Readers who saw EMI's *June 1994 issue will have been introduced to Ken Lovelett and some of his sculptural percussion instruments. Here are three more short articles on innovative instruments from Ken Lovelett.*

DRUMS FOR THE 21st CENTURY

By Kris Lovelett

Protocussion, a small and growing drum company in Upstate New York near Woodstock, has developed a new and exciting technique in the art of drum making. The drums that take the name of the man who created them, "Lovelett," were patented in 1991 and feature many of the unique and innovative ideas that have come to represent Protocussion.

Sound rings that protrude from the Lovelett Drum are the first noticeable feature. As can be seen in the photograph, these sound rings are like ledges extending out form the side of the drum all around its circumference. They accept the lug screws that hold the drum head in place. Through the process of translocation, vibrations from the drum head and rim are transferred back into the drum via the lug screws into the sound ring, which creates a more resonant drum shell. Protocussion's sound rings eliminate the need to attach metal lugs, many of whose internal springs vibrate, to the drum cylinder. They also reduce stress on the rest of the drum. As a result, a much more clean and pure sound is obtained.

THE LOVELETT DRUM

Another innovation is the bearing edge of the drum where the drum skin passes over the rim of the shell. Protocussion's Ken Lovelett has found that with a variety of bearing edge shapes, a multitude of sound characteristics may be created. In addition to a standard bearing edge, when a rounded edge is applied, overtones are substantially reduced, while an edge that is peaked or pointed toward the center will give the tone a greater amount of ring.

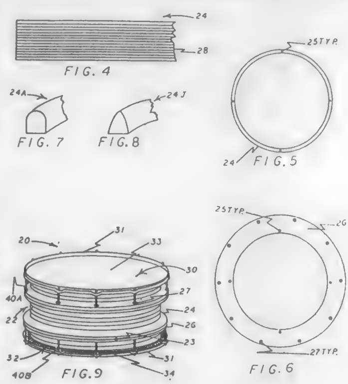
Multi-annular ring construction is another patented feature which gives the Lovelett Drum its unique appearance as well as its strength, making it the strongest wood drum shell made. In multi-annular construction, the drum shell is built up by laminating rings of solid wood on top of one another, rather than making the shell in the traditional way from multiple wraps of thin, bent plywood.

Due to its innovative construction, the drum will never lose its cylindrical shape whether a drum head is or is not mounted, thus making the drum extremely durable and impervious to stress.

This construction technique has also led to a plethora of possibilities in this versatile Lovelett Drum. Drums can be made to any depth, from a pancake drum of just under two inches made of only a sound ring and a bearing edge, to a large drum measuring forty-eight inches or more. Aside from depth, shell thickness may also vary. Drums of larger or smaller diameters and drums of increased or decreased thickness may be crafted by creating thicker or thinner multi-annular rings. Moreover, when a cylinder made of material other than stacked multi-annular rings, such as metal, plexiglass or wood, is used together with the Lovelett sound rings, even more variation of sound can be attained.

Aside from variations of shape, construction, size and sound, different finishes can also be applied such as opaque shellacs, wood varnishes and a special solid paint that will buff out scratches. These finishes will not only enhance the drum's look, but also protect the wood.

With all the Lovelett Drum's innovations, a world of possibility has been opened for all percussion instruments. Utilizing obvious modifications, tambourines and banjos are just a few of the many drum-like percussion instruments that can be crafted with the techniques described in Lovelett's



Drawings from the Lovelett Drum patent, showing various facets of the design. U.S. Pat. No. 4,993,304

patent (U.S. 4,993,304, issued February 19, 1991).

Protocussion's combination of revolutionary sound rings, variable bearing edges, durable multi-annular construction, and a selection of beautiful finishes, all illustrate Protocussion's commitment to new and unique methods in crafting not only the Lovelett Drum, but also an entire generation of percussion instruments.

THE BUSKER

by Christopher White

A "Busker" is an English street musician, especially a "One-Man Band". It is also the very appropriate name given to a new sound sculpture by Ken Lovelett. Ken's Busker (pictured on the front cover of this issue) is a sonic sculptural assemblage that finely balances between the poles of art and function. The object/instrument dichotomy is rarely held in such satisfying equipoise.

Ken always has his ear attuned for musically usable sounds and his eye open for structurally interesting forms. The Busker owes its overall shape to a clothes rack purchased at Big Scott's going-out-of-business sale twelve years ago. Ken saw the chrome spiral stand and immediately envisioned it festooned with objects which could be struck, plucked, scraped, and otherwise caused to make musically satisfying sounds.

During the intervening years Ken has scavenged, purchased, adapted, and constructed innumerable sound makers and sound shapers. As individual items are added to the inventory, Ken continually experiments with their incorporation within larger structures like The Busker. Eventually, each of Ken's sonic sculptures begins to establish its own, unique, if related, character. Certain musical tonalities and contexts develop for each assemblage alongside their individual visual and spatial logic.

When one looks at the Busker the first feature to catch the eye is likely to be the teardrop-shaped conical steel resonator on top. It both provides a witty visual "hat" for the man-sized Busker and colors many of the near field sounds. It focuses and, therefore, seemingly amplifies those sounds as well as adding reverberance. The resonator tops a 20" bicycle wheel with tuned spokes. Ken has positioned cardboard attached to clothespins with handles below the wheel. It's the old "Boy on a Bike with Baseball cards" setup filtered through a musician's aesthetic. The handles attached to the clothes pins are used to change the angle and pressure of the cards hitting the tuned spokes, giving a greater dynamic range. The sound produced is simultaneously similar to a ratchet and steel drum.

Below this are four PVC tubes cut to different lengths and played with three-inch styrofoam ball mallets. Next are three aluminum chimes and a large spring stretched to about three feet. Also there is a six-sided aluminum star that has many overtones.

A sound source Ken discovered many years ago which has been useful in a number of sonic assemblages is the tin drum. As in the case of The Busker, Ken usually groups a few tin drums of different sizes together. They are cardboard canisters with tin tops and plastic bottoms. Ken paints each drum individually in brightly colored patterns. The tin drums are also attached to foot bellows that pump air into the drums creating pitch shifts. The sound is similar to a steel drum with a glissando. Continuing down the arc of The Busker's spiral from the tin drums there is an eleven-inch vibraphone bar. There is also a five-inch, fine-toothed metal gear that has a very high expanding pitch.

Next is a twelve-inch aluminum disc with a long-lasting mid-range pitch. Two pan-shaped discs have short but distinct pitches. The next item is an exhaust pipe from a Kero-sun Moniter 20™ heater — another example of Ken finding multiple purposes for an item, since he is a registered Kero-sun™ dealer. The pipe is musically versatile because it has an aluminum guiro sound when scraped and a nice bell note when struck. Next is a drum with a steel top head and a cardboard bottom head that is fourteen inches in diameter and two and a half inches thick. Like many of Ken's other drums, it is also connected to a foot bellows for a low glissando effect. The Busker ends in a "skirt" made of twenty-three copper chimes in graduated lengths.

Ken is currently readying a new venue for displaying his sound sculptures, the *Sonart Gallery*. The gallery is intended as a space for both exhibitions of and performances on sonic sculpture. Ken has numerous works of his own which will be on display, and in addition he invites anyone with a similar approach or concept to contact him (his address follows these articles). While certain aspects of the operation remain uncertain, Ken hopes to create an advisory board and expand the scope of *Sonart Gallery's* activities significantly over the next couple of years. It is hoped that this will become a première showcase for innovative instruments which embody visual/sculptural excellence as well as having musical use and interest.

THE NAKERS

By Kris Lovelett

Featured in the June 1994 issue of *EMI* (Volume IX #4) was an article by Ken Lovelett dealing with one of his sound sculptures called the "Naggara Drums." The sculpture consists of five clay drums connected to two foot bellows and nestled in a finely crafted wooden table with an arc rising above and spanning across. Ken has received many inquiries about this particular instrument.

In response to this interest and his on-going inventive spirit, Ken has created a new sound sculpture, "Nakers," (pictured next page) that shares many characteristics similar to the Naggara Drums. Like its predecessor, the Nakers is fashioned in a similar style, but now with only two clay, dumbek-shaped drums of equal size that rest in another finely crafted wooden table. While one drum of the Nakers has a very thin head, the other's head is much thicker, allowing for a varied timbre attributed to varying head thicknesses. Each drum is also coated with a bright, brass glaze that not only beautifully reflects light, but also enhances and compliments the natural grain and finish of the table. The glaze of the drums, however, is not the only thing that will catch the

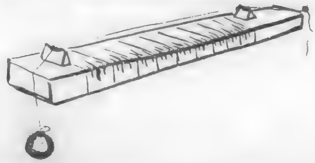
eye of anyone who sees the Nakers, for a hand-carved cherry wood block lies between the two drums whose purpose is to break-up the sound of the drums rhythmically and sonically while also adding character to appearance and sound.

Aside from visual appeal, special felt mallets and bamboo brushes created for the Nakers can add even more variety of sound. One can strike the shoulder of the mallet against the clay rim while simultaneously hitting the felt tip on the drum's head to create a unique sound. Variation can be furthered when combinations of four mallets or brushes are used in unison, or in independent rhythmic combinations. In addition, two wooden pedals, each with a styrofoam ball attached to the end of a dowel, extend up into the bottom of each drum, and when a pedal is depressed, the styrofoam ball is lowered. This increases the volume of air in the drum, thereby changing the drum's pitch, giving even more musical potential and variety to the Nakers. Unlike the Naggara Drums, however, the Nakers produces a more definitively pitched note, rather than a glissando effect. This is especially evident when a pedal of the Nakers is held in the same position.

When considering the numerous possibilities including the pitch-varying pumps, drums with different head thicknesses, wooden block, and special techniques such as hitting both the rim and head, using four mallets, or using bamboo or felt in combination, the Nakers are uniquely able to offer any array of pitch, timbrel or rhythmic effects.

Ken Lovelett and the Protocussion can be reached care of SONART, PO Box 65 Mount Tremper, NY 12457; Phone: (914)-688-7620; Fax: (914)-688-5299. Your questions, comments, thoughts and suggestions are welcome, as are manufacturer and dealer inquiries.

THE MONOCHORD

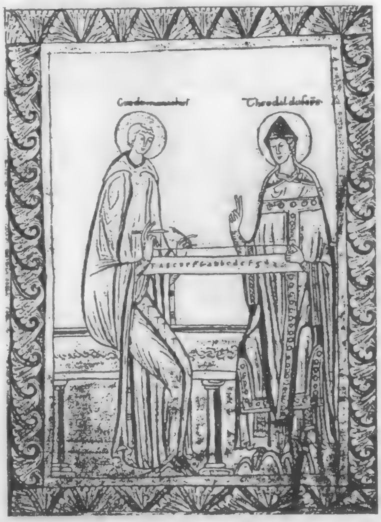


by Sasha Bogdanowitsch

The monochord is a single string instrument that had its origins in ancient Greece in about the sixth century B.C. There it was used for experimentation and teaching, and for demonstrating the laws of the vibrating string and their applications to musical scales and harmony. The Greeks knew the instrument as a simple string, of either wire or gut, stretched across fixed bridges erected on a table; the string being held down by the tension of weights. A moveable bridge was placed underneath the single string, dividing it into two sections. Marks on the table indicated different positions for this moveable bridge. The player would pluck or bow the string with one hand and hold the tension of the string over the moveable bridge with the other.

As a more popular instrument in the Middle Ages and the Renaissance, the monochord's resonance was improved by the construction of a long, narrow, wooden, rectangular sound box. A calibrated ruler under the string replaced the marks on the table.

Since the theory of the monochord, or divisions of the string, goes hand in hand with its history, in this article we will take a historical approach to the subject, starting again from its origins in ancient Greece, proceeding through medieval times, and ending with the present day.



In sixth century B.C. Greece, the monochord (or 'kanon' as it was known in Greek) was first used as a theoretical and testing device by the Greek philosopher, mathematician, and spiritual teacher, Pythagoras of Samos, who apparently learnt of the instrument's construction and use while studying in Babylon.

Pythagoras was widely known for attracting a large following of people in teaching his way of life, which focused on a life geared towards the purification of the soul. For him, the key to perfection lay in number and its relation to humankind, nature and the universe. The monochord was to be the instrument or vehicle that would allow these numeric relations to manifest themselves in sound. So important was the monochord to Pythagoras that, before dying, one of the last things he reminded his disciples to do was to continue the study of the monochord.

There is a legendary incident, often recounted, in which Pythagoras chanced to pass by a smithy. There he heard the pounding of hammers on anvils producing between them certain musical consonances. Having been seeking a numeric basis for consonance, Pythagoras set out to determine what characteristics accounted for the consonances between the hammering of the several smiths. He eventually concluded that the explanation lay in the relative weights of their hammers: Where one hammer weighed twice as much as another, the two would produce between them the interval of an octave. Where one weighed 4/3 as much as another, the interval would be a fourth, and so on, with certain ratios corresponding to certain intervals. As the story continues, he tested this hypothesis, in other applications, including struck glasses filled with water, blown pipes, and lengths of string tensioned by weights. The problem with this story is that the hypothesis is false — at least as concerns the effect of weight. There is no consistent relationship between an object's weight and its sounding pitch. But Pythagoras was right on the mark with the notion that ratios are central to the phenomenon of consonance. They are, in fact,

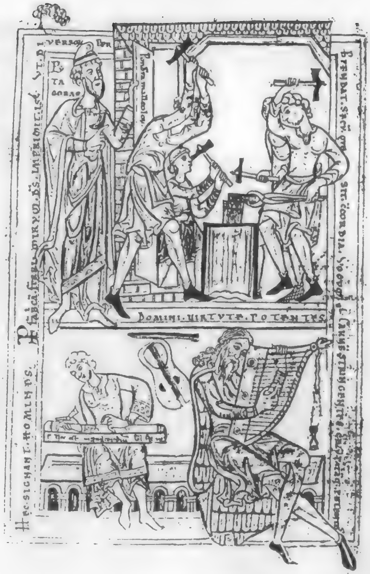
OLD AND NEW

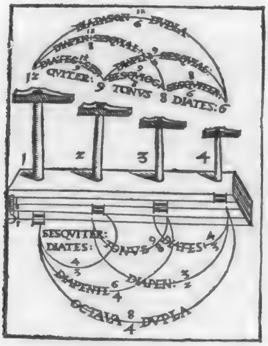
Above: From a twelfth-century German manuscript, a depiction of the monochord with Bishop Theobald of Arezzo and Guido of Arezzo.

Right: Contemporary composers-makers-theorists Lou Harrison and Bill Colvig designed and bult this monochord.

Right: A medieval depiction of Pythagoras at the smithy.

Below: From Martin Agricola's *Musica instrumentalis deudech*, 1529, a diagrammatic representation, combining images of hammers with music notation, showing the purported Pythagorean relationships between weight and pitch.





the heart of the matter.

Working with the monochord, Pythagoras was able to apply the ratio hypothesis to relative string lengths, where it indeed holds true. He found that if a string is divided by a bridge at the center into two string segemnts of half the length, each will produce a tone an octave above the original string tone. A vibrating string segment of three quarter of the full string length will produce a tone a fourth higher; two thirds will produce a fifth higher, and so on: the string length proportions correspond to musical intervals, and the simplest proportions correspond to the most basic intervals.

To this we can add another fact, perhaps not known to Pythagoras but extremely valuable to our own understanding: other things being equal, string length is inversely proportional to vibrational frequency. Thus a string shortened to half its original length will vibrate at twice its original frequency; one shortened to three fourths as long will vibrate at 4/3 the frequency, and so on. These frequency relationships, revealed in inverse in the monochord's string length relationships, are the raw material of musical intervals and scales, providing the numeric basis that Pythagoras sought.

Following Pythagoras, other Greek theoreticians including Archytas, Aristoxenus, Adrastus, Aristicles, Didymus, Erasthus, Eratosthenes, Nichomachus, and Thrasyllus continued to study the monochord. They developed sets of principles based in the division of the string into halves, thirds, fourths, fifths, and sixths. From these divisions they were able to derive the intervals of the octave (2:1), the fifth (3:2), and the fourth (4:3). The second (9:8) then appeared as the difference between the fourth and fifth, corresponding to 1/9 of the string length. They applied these four ratios in different ways to achieve various versions of the Greek tetrachordal genera, the diatonic, chromatic, and the enharmonic; with further modal variants achieved through transposition to different scale degrees. (The term "tetrachord" refers to a set of four tones spread over the interval of a fourth. Two tetrachords, one above the other with the interval of a second between them, together comprise a scale over one octave. Tetrachords in various configurations were used as a tool for building and conceptualizing scales.)

None of these early theoreticians left any writings on the specifics of the construction of the monochord. This, along with information concerning the instrument's precision, inaccuracies, and performance practice, first appears in the writings of the Alexandrian mathematician, geographer, astronomer, and music theorist Claudius Ptolemy (83-161 A.D.).

Ptolemy goes into great detail in his text *Harmonics* in regards to the monochord's construction (see the diagram below). He particularly stresses the importance of the bridges being exactly perpendicular to the surface (AB) and of equal height (CD=EF), and the string (ADFB) being parallel to the surface, to ensure the accuracy of the measurements of the ruler (the measuring rod or 'kanonian'). Ptolemy found other Greek musical instruments, such as the reed shawm, the aulos, and the panpipe, the syrinx, to be imprecise because of the unevenness of their bores. The monochord, he professed, was, firstly, equipped with a way of assessing any uneveness that might arise from the instrument and, secondly, its limits were so positioned that they had clear and suitable points of origin for the plucked sections of the string.

On the other hand, he found inaccuracies with it in regards to its use as a performing instrument. Ptolemy mentions two main tasks for which it was ill-suited: first, the accurate production of musically acceptable melodic intervals and, second, the demonstration of their mutual relationship with the ratios come upon by logical reasoning. These statements largely meant that the musicians did not throughly check their monochords for the evenness of the string and the precise positions of the bridges, and therefore did not make their divisions by reason, but by ear.

Ptolemy also noted that the bridge of the monochord could not be accurately moved at a fast speed and the 'gliss-like' sound of it so doing was not considered musical. Furthermore, the variety of musical techniques such as legato playing, trills, striking notes together, and large interval leaps could not be executed properly. To counter all this, however, Ptolemy added the confusing information that these were the reasons that it should not be played solo, and that it was actually played accompanied by the aulos and syrinx.

We jump now to the beginnings of the medieval era with the Roman writer, statesman and musical theorist, Anicius Manlius

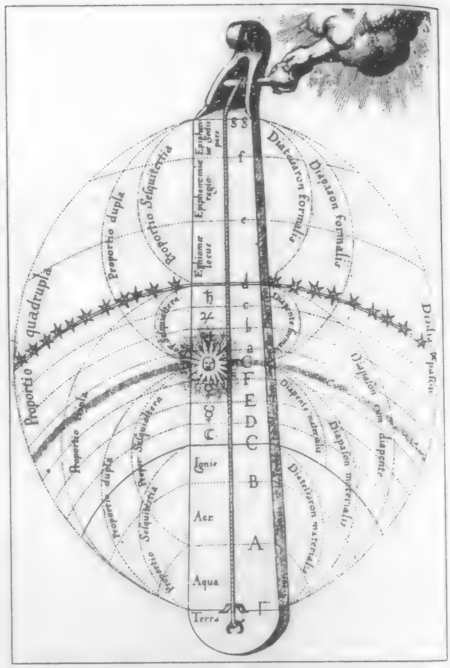
Spatial relationships in Ptolemy's monochord

Severius Boethius (480-524A.D.) His work, *Fundamentals of Music*, which was a treatise largely based on the writings of Nicomachus and Ptolemy, was the only known work throughout the Middle Ages that explained the leading principles in monochord division, as well as the Greek Perfect System of the tetrachord theory. This system was centered around the combination of tetrachords of identical shape, either connected by a common note or separated by a whole tone. At this time, the monochord was still used in the same manner as in ancient Greece. In addition, it served as an aid in teaching solmization, sight singing, and rote singing based on the hexachord system designed by Guido of Arezzo using fixed pitches.

For Boethius, "the ratios of the consonances could be manipulated to create ratios for intervals smaller than the tone, ..., all the ratios, in turn, could be referred to the monochord, so that the senses can appreciate the musical sounds embodying the mathematical ratios."[1] Boethius demostrated this fully in mapping out on the monochord all three classical Greek genera and their transpositions. See the sidebar near the end of this article for a description of one of his procedures.

In the Renaissance and Baroque eras, the monochord became an aid in tuning organs and bells. One description explains, ". . . on arriving at the church the tuner, accompanied by an apprentice who carried the monochord, would proceed to tune the the monochord to a trumpet brought along for that purpose, and then to tune the organ to the monochord."[2]

It was during this time and shortly after that the instrument was also used as a symbolic device in works of art and illustrated manuscripts, like Robert Fludd's divine world-monochord, appearing in his 1617 publication, *History of the Macrocosm and Microcosm* (shown at right). In such appearances the monochord was used to to express the Pythagorean teachings of the ordered unity existing between Humanity and the Universe. The solar system, the Muses, or the zodiac were often represented as pitches on the divided string, tuned by the hand of God.



Above: The "Divine Monochord", or "World Monochord", from *History of the Microcosm and Macrocosm* by Robert Fludd, 1617.

Below left: Boethius playing the monochord, form a twelfth-century English manuscript of Boethius' *De Musica* (in Cambridge Univ. Library).

Following that period and until much more recently, the monochord seems to disappear from musical history, making way for the piano, which became the instrument by which to judge everything else. Then, toward the end of the 19th century and the start of the 20th, we find a resurgence of the monochord. The German physicist Hermann Helmholtz, in his foundational acoustics text *On the Sensations of Tone* (1885), discusses investigations with the monochord and stresses the significance of whole number ratios. The English scientist, Sir James Jeans, in his 1937 work, *Science and Music*, also presented well known and ancient monochord experiments. Composer and instrument builder Harry Partch, in his 1949 publication *Genesis of a Music*, points to the monochord as an essential source for understanding underlying physical principles of music. And up to the present day, Lou Harrison and Bill Colvig have sought to awaken the old truths manifest in the single-string instrument — truths that were almost washed away by the dominance of equal tempered tuning and the Western keyboard.

Indeed, it was composer Lou Harrison and instrument builder Bill Colvig who were the first ones to spark this author's interest in the monochord. They both

1 Boethius, Anicus Manlius Severinus, *Fundamentals of Music*, translated by Calvin Bower, Yale University Press, 1989, page xxiv.

2 This description, based upon "many detailed references" in "the organ literature of the baroque," is from the "Monochord" entry in Sibyl Marcuse's *Musical Instruments: A Comprehensive Dictionary*,

have made quite an impact on musicians, instrument builders and theorists of the present day by stressing the importance of the instrument as a musical and tuning tool. More fundamentally, they have shown how it represents the beginnings of our musical universe by demonstrating the primal facts of nature's harmonics — therein lying the essence of just intonation or the method of tuning using simple whole number ratios. Lou Harrison writes of the monochord in his poem, 'Ode on the Monochord,' from his poetry book, *Joys and Perplexities* (published by the Jargon Society with the University Library of UCSC and the Cabrillo Music Festival, 1992):

Thin shining stretch of vibrant tuneful wire
pulled taut to teach each measured interval
of song & dance & hymn —
the slim monochord is lord of melody.

The shimmering string is like a branch to
bloom into tunes, to curl & trill in tones
gardens of melody,
exhaustless glories, glimmering lines of joy.

Along string's swift & glistening path
we trace the overtones & sweet stoppings
that are of our music
all its measurement & all its spell & heart.

As he had brought it west from Babylon
Pythagoras enjoined its use in schools,
&, as he marked it off,
so millions knew their music & modalities.

His old Sumerian measurements still make
the two-stepped, bright, unsettled melodies
that are ancestral too
to all our modes, & every tuning cycle.

Archytas touched the melodious chord
& Eratosthenes, who was the first
of men to measure Earth—
these & all such men came to this instrument.

Along trembling tuneful shining wire we
hear the careful tones that Ptolemy made
in Alexandria,
who wrote in numbered ratios all his tunings.

The monochord is lord of melody
& such sweet division sings from its wire,
so wonderous this beauty,
we are moved to laud all who have made a mode.

Finally, in this overview of the one-string instrument and its history, we must not forget the other instruments the monochord has inspired, and those it can claim in its extended family in the Eastern and Western worlds.

One such instrument in the West was the trumpet marina. It was a bowed monochord played entirely in harmonics, in use from the 15th to mid 18th centuries. It featured an unusual form of buzzing bridge that served to enhance the tone and increase the instrument's volume. It was capable of sounding up to the 16th partial, and used the partials 6, 8, and 13 prominently in its melodies.

Two instruments of Asian origin are the Vietnamese dan-bau and the North Indian alapini or ekatantri vina. The dan-bau is a single string box zither with a flexible bamboo stem that holds a gourd for a resonator. By striking with a stick, moving the bamboo stem, and using the backside of the hand to stop the string, a wide variety of harmonics can be produced. The alapini or ekatantri vina was a medieval one-string stick zither used from the 6th to 13th centuries. It consisted of a large piece of bamboo with a buzzing bridge and gourd resonators. One hand would pluck the string while the finger of the other hand lightly touched the selected harmonic points along the string.

While the earliest monochords had a single string, many later monochords have been made with two. Having a second string is helpful when it comes to comparing the two pitches of an interval. Having a full array of strings on a monochord-like instrument would open further possibilities yet. Several such many-stringed instruments exist, bearing important relationships to the monochord both conceptual and historical. Among them are the harmonic kanon of ancient Greece, the Arabic kanun, and the European clavichord. But they deserve an article unto themselves ... they will be focussed on at a later date in *EMI*.

CONSTRUCTION OF A MONOCHORD

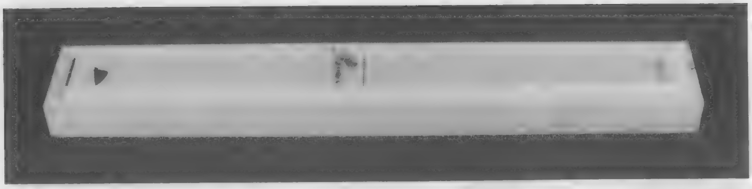
Instrument builder Bill Slye and myself designed and constructed an accurate monochord inspired by Bill Colvig and Lou Harrison's beautiful monochord pictured at the start of this article.

A typical monochord takes the form of a long box zither. The design can be quite simple, and the construction of it relatively easy, in all the components but one: the movable bridge. The bridge presents a design challenge because of the requirement that it not deflect the string.

Here is why the bridge must not deflect the string: With most string instuments, the bridge is wedged between the strings and the soundboard, pushing the strings up and away from the board, so that they bend at the point where they cross. The resulting downward pressure of the strings helps keep the bridge in place. It also assures solid contact between the string and bridge, and between the bridge and soundboard. This makes for good vibration transmission, without buzzing or rattling. But with the monochord, the string must not bend at the point where it crosses the bridge. If it did, the resulting stretching of the string would throw the sounding pitch off relative to the mathematical measurements. Without the option of the wedging effect, some other means must be found to assure that the monochord string maintains positive contact with the bridge, and the bridge with the soundboard. One solution to this problem for contemporary monochord makers has been to create a movable bridge with some sort of sliding track below to hold it firmly to the soundboard, and a pinching mechanism above to hold the string firmly to the bridge at the crossing point. That is what Bill Slye and I have done with this monochord.

For the rectangular sound box, we used the hardwood, maple. We cut the two sides at about 45 ½" long, 1/2" wide, and 3" high. We cut the two end pieces at about 5" long, 13/16" wide, and 3" high. Our top was of mahogany plywood about 1/8" thick and cut about 43 13/16" long and 5" wide. The sides were put together so that the 5" pieces were inserted within, making a 6 5/8" width all together. The top was inset in about 3/4" from the top and supported by two 43¾" long and 3/4" wide pieces glued to the sides inside. This was done to accomodate a sliding plastic hinged bridge that would clamp the string from above and below, hopefully avoiding any deflection of the string.

Because of some inaccuracies in cutting our top, we added some trim to all the inner sides atop. This made it look quite nice, and after alot of

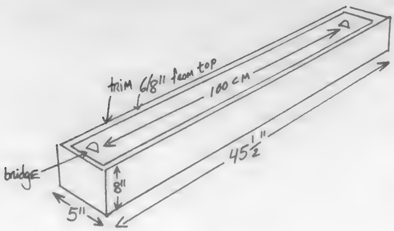


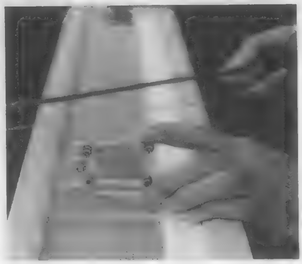
Monochord by
Sasha Bogdanowitsch
and Bill Slye

Top: The full instrument.

Smaller photo: Detail of the movable pinching bridge.

Drawing : Dimensions.



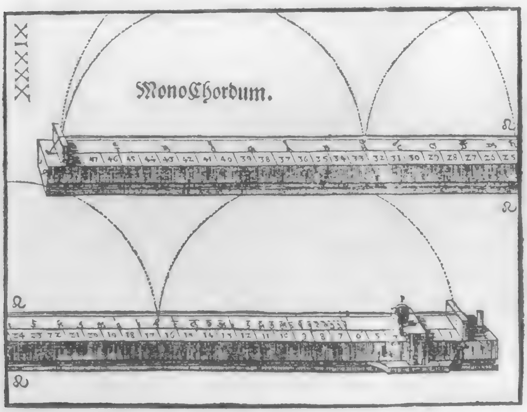


careful sanding, it provided smooth riding for our bridge.

For our fixed bridges, we used some spare walnut pieces cut into triangles, sanding off excess that didn't need to be there. They were glued exactly 100 cm apart. We used a standard zither pin for one end to hold the string and a kotter pin on the other end. For the string we used a standard small-gauge piano wire about 1 mm in diameter.

The movable bridge was a bit more difficult, but when finished, it proved to be quite effective. We went to a plastic store and got a 4" wide, 4½" long, and 1/8" high clear plastic piece to be the top. Another piece, shorter by 1/2", but with the other dimensions the same, would be the bottom. That 1/2" space would allow for the piece of cardboard that would be marked with all our ratios and lines, telling the player where to find the pitches.

On the top of the plastic platform we made a cut with a Stanley knife through the middle, putting a hole at the end to accomodate marking on the piece of cardboard. Also on the top was to be the opening and closing jaws bridge, which was to allow for ease and accuracy in not bending the string too much when stopping the string to hear the corresponding ratio. We used sanded galvanized metal for the blades that would be inserted between the plastic jaws. For dimensions and visual representation, see the figure above. Since the blades happened to be rather thin, we decided to add two small plastic pieces, 1 1/2" long and 5/8" wide, to support the system. In the end, we ended up with a beautiful little sliding bridge and monochord to realize modes and tunings of any shape and size.



Monochord drawing from Michael Praetorius' *Syntagma Musicum*, Volume II, *De organographia* (1620).

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GENERATING THE PYTHAGORIAN DIATONIC ON THE MONOCHORD, ACCORDING TO BOETHIUS

To illustrate the approach to scale-making practiced by Anicius Manlius Severius Boethius and his Greek antecedents, we will explore his method for generating one of the classical Greek genera, the traditional Pythagorean diatonic genus in two octaves. The frequency ratios of this scale are: 1/1, 9/8, 32/27, 4/3, 3/2, 128/81, 16/9, and 2/1. The scale can be seen as a combination of two tetrachords, each containing two whole tones and semitone, with the ratios 9:8, 9:8, and 256:243 being used for these respectively. Traditionally, to connect the two disjunct tetrachords, a 9:8 was inserted between them.

Let us follow the step by step construction of this scale on the monochord, using letters to signify places on the string (see Diagrams 1-3). We shall have AB as our length of string. For the sake of simplicity, we will assume this string length to be 100cm. (To see all the below ratios in centimeter lengths, see "Boethius' Diatonic" in the chart of monochord tunings on the following page.) The open string on our monochord may be tuned to any note. This open-string note will serve as the fundamental pitch of the scale. Each pitch of the scale will be identified by the ratio of its frequency to the frequency of this fundamental pitch. We can think of this fundamental pitch, then, as the unison pitch with a ratio to itself of 1/1.

We start by dividing the whole string length into four equal parts, AC, CD, DE, and EB (Diagram 1). Within this, you can see two half-string lengths DB and AD. If you were to insert a bridge in the middle at D and pluck the half-string length DB or AD on either side, you would hear a tone an octave above our fundamental tone, at a frequency ratio of 2/1. (This follows from the inverse relationship between string length and frequency: other things being equal, a string half as long will vibrate at twice the frequency.) Likewise, the quarter-string segments AC and/or EB would produce a tone two octaves (4/1) above the fundamental. Now, taking three of the four equal parts (we'll take CB), we get the interval of a perfect fourth (4/3) over the fundamental. Meanwhile, the interval between the two segments DB and CB yields a perfect fifth (3/2).

If we divide this string into three equal parts, a segment containing two parts (GB) will yield the perfect fifth (3/2) above our fundamental. In comparing the the two segment GB to the segment CB we find a difference of a whole tone (9/8).

Taking the entire length again and dividing it into nine equal parts, we can take the segment FB (representing eight ninths of the full string length) to yield the whole tone (9/8) above our fundamental.

Up to now, we have the second, fourth, fifth, and octave degrees of our scale. To get the seventh degree, we divide the segment CB into four equal parts, one of those four being BK (Diagram 2) which will be our minor seventh (16/9) above the tonic.

To generate the same intervals in the second octave, we can perform the same set of subdivisions on the half-string DB. This yields the ninth at a ratio of 9/4 in the string segment LB, the perfect eleventh (8/3; MB), the perfect twelfth (3/1, NB), and the minor fourteenth (32/9, KX).

But all these travels on the monochord still do not give us the much-needed semitones that will connect these tetrachords. To get these, first, we shall divide the segment CB into eight parts, taking one of those parts and adding it to CB, making OB, which will be our minor third (32/27) above our fundamental tone (Diagram 3). Secondly, KB will be divided into eight parts, one of those being added back to KB, making PB, which is our minor sixth (128/81) above our fundamental tone. If the same procedure is done for MB and XB respectively, we will get RB and SB making the intervals of the minor tenth (64/27) and the minor thirteeth (256/81). Thus, we find that all the semitones of our scale occur between the lengths of OB and FB, PB and GB, RB and LB , and SB and NB. This completes the entire two octave range of our scale, which Boethius called the Pythagorean diatonic, or the Lydian scale. In ancient Greek terms it would probably be called hypodorian. To modern western musicians, it will be familiar as the natural minor scale, or aeolian mode.

Contemporary readers should be aware that the ancient approach to monochordal scale-study described here, in which all operations are based in equal subdivisions of the string, is not the only possible approach. A more common approach in recent times has been to work more directly from the calibrated ruler beneath the string. If you know what ratios you're looking for, you can calculate string length ratios directly, without taking the preliminary step of calculating and marking off a whole set of equal subdivisions the string. In the chart on the following page you will find information geared to this approach, in the form of centimeter values representing string-stopping points to produce different intervals and scales on a 100cm monochord string.

Diagram 1

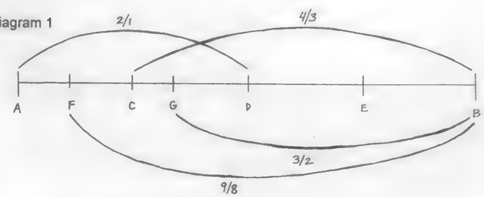


Diagram 2

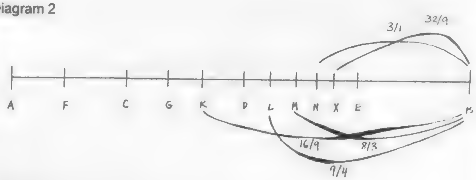
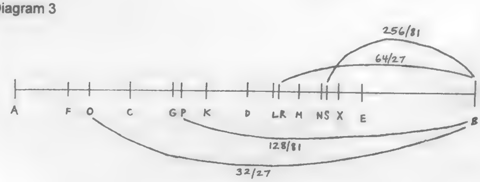


Diagram 3



SCALE CHARTS FOR MONOCHORD

At right are two charts designed to aid the monochord seeker in tuning up various historical and "world" scales. Most of the historical scales shown are Greek, with the addition of a Babylonian scale and the scale from Boethius discussed earlier. Among the others are versions of some eastern scales, plus the harmonic series, 12-tone equal temperament and traditional just inotonation 5-limit and 7-limit scales. The numbers given here are for a monochord with a string length of 100cm. For each scale, the middle row gives the pitches of the scale relative to the fundamental pitch, in ratios, with the fundamental pitch appearing as 1/1 and the octave as 2/1. The upper row indicates the intervals between the scale steps, again in ratios. The bottom row gives the string stopping points required to produce each pitch. These numbers represent the point at which the movable bridge should be placed, as a distance in centimeters from one end of the string. To calculate other scales of your own, decide upon the ratios to define the scale, and divide each one in turn into 100 centimeters. For example, to obtain the string stopping point for the second degree of the Javanese slendro (8/7), we do thus:

100 ÷ 8/7 = 100 • 7/8 = 700/8 = 87.50.

BABYLONIAN 'ISHARTUM'	Intervals	256:243 – 9:8 – 9:8 – 9:8 – 256:243 – 9:8 – 9:8												
	Ratios	1/1	256/243		32/27		4/3		3/2	128/81		16/9		2/1
	Stopping points	100	94.92		84.38		75		66.67	63.28		56.25		50
ARCHYTAS' DIATONIC	Intervals	28:27 – 8:7 – 9:8 – 9:8 – 28:27 – 8:7 – 9:8												
	Ratios	1/1	28/27		32/27		4/3		3/2	14/9		16/9		2/1
	Stopping points	100	96.43		84.38		75		66.67	64.29		56.25		50
ARCHYTAS' CHROMATIC	Intervals	28:27 – 243:224 – 32:37 – 9:8 – 28:27 – 243:224 – 32:27												
	Ratios	1/1	28/27	9/8			4/3		3/2	14/9		27/16		2/1
	Stopping points	100	96.43	88.89			75		66.67	64.29		59.26		50
ARCHYTAS' ENHARMONIC	Intervals	28:27 – 36:35 – 5:4 – 9:8 – 28:27 – 36:35 – 5:4												
	Ratios	1/1	28/27	16/15			4/3		3/2	14/9	8/5			2/1
	Stopping points	100	96.43	93.75			75		66.67	64.29	62.50			50
DIDYMUS' ENHARMONIC	Intervals	32:31 – 31:30 – 5:4 – 9:8 – 32:31 – 31:30 – 5:4												
	Ratios	1/1	32/31	16/15			4/3		3/2	48/31	8/5			2/1
	Stopping points	100	96.88	93.75			75		66.67	64.58	62.50			50
PTOLEMY'S SYNTONIC DIATONIC	Intervals	9:8 – 10:9 – 16:15 – 9:8 – 10:9 – 9:8												
	Ratios	1/1		9/8		5/4	4/3		3/2		5/3		15/8	2/1
	Stopping points	100		88.89		80	75		66.67		60		53.33	50
PTOLEMY'S MALAKON DIATONIC	Intervals	21:20 – 10:9 – 8:7 – 9:8 – 21:20 – 10:9 – 8:7												
	Ratios	1/1	21/20		7/6		4/3		3/2	63/40		7/4		2/1
	Stopping points	100	95.24		85.71		75		66.67	63.49		57.14		50
FIRST THIRTEEN PARTIALS OF THE HARMONIC SERIES	Intervals	2:1 – 3:2 – 4:3 – 5:4 – 6:5 – 7:6 – 8:7 – 9:8 – 10:9 – 11:10 – 12:11 – 13:12												
	Ratios	1/1	2/1	3/1	4/1	5/1	6/1	7/1	8/1	9/1	10/1	11/1	12/1	13/1
	Stopping points	100	50	33.33	25	20	16.67	14.29	12.50	11.11	10	9.09	8.33	7.69

BOETHIUS' DIATONIC	Intervals	9:8 – 256:243 – 9:8 – 9:8 – 256:243 – 9:8 – 9:8												
	Ratios	1/1		9/8	32/27		4/3		3/2	128/81		16/9		2/1
	Stopping points	100		88.89	84.38		75		66.67	63.28		56.25		50
BOETHIUS' DIATONIC	Intervals	9:8 – 256:243 – 9:8 – 9:8 – 256:243 – 9:8 – 9:8												
	Ratios	2/1		9/4	64/27		8/3		3/1	256/81		32/9		4/1
	Stopping points	50		44.44	42.19		37.50		33.33	31.64		28.12		25
JAVANESE "SLENDRO"	Intervals	8:7 – 7:6 – 8:7 – 147:128 – 8:7												
	Ratios	1/1		8/7			4/3		32/21			7/4		2/1
	Stopping points	100		87.50			75		65.62			57.14		50
INDIAN "YAMAN"	Intervals	9:8 – 10:9 – 9:8 – 16:15 – 9:8 – 10:9 – 16:15												
	Ratios	1/1		9/8		5/4		45/32	3/2		27/16		15/8	2/1
	Stopping points	100		88.89		80		71.11	66.67		59.26		53.33	50
PERSIAN "CHAHRGAH"	Intervals	2187:2048 – 2560:2187 – 16:15 – 9:8 – 121:120 – 150:121 – 16:15												
	Ratios	1/1	2187/2048			5/4	4/3		3/2	121/80			15/8	2/1
	Stopping points	100	93.64			80	75		66.67	66.12			53.33	50
FIVE LIMIT JUST CHROMATIC	Intervals	16:15 – 135:128 – 16:15 – 25:24 – 16:15 – 16:15 – 135:128 – 16:15 – 25:24 – 16:15 – 135:128 – 16:15												
	Ratios	1/1	16/15	9/8	6/5	5/4	4/3	64/45	3/2	8/5	5/3	16/9	15/8	2/1
	Stopping points	100	93.75	88.89	83.33	80	75	70.31	66.67	62.50	60	56.25	53.33	50
EQUAL TEMPERAMENT CHROMATIC	Intervals	$9438743/10^7$ (each of the 12 steps)												
	Ratios	1/1	$10594631/10^7$	$1122462/10^6$	$11892071/10^7$	$1259921/10^6$	$13348399/10^7$	$14142136/10^7$	$14983071/10^7$	$15874011/10^7$	$16817928/10^7$	$17817974/10^7$	$18877486/10^7$	2/1
	Stopping points	100	94.38	89.08	84.08	79.37	74.91	70.71	66.74	62.99	59.46	56.12	52.97	50
SEVEN LIMIT JUST CHROMATIC	Intervals	15:14 – 21:20 – 28:27 – 15:14 – 16:15 – 21:20 – 15:14 – 28:27 – 15:14 – 21:20 – 15:4 – 16:15												
	Ratios	1/1	15/14	9/8	7/6	5/4	4/3	7/5	3/2	14/9	5/3	7/4	15/8	2/1
	Stopping points	100	93.33	88.89	85.71	80	75	71.43	66.67	64.29	60	57.14	53.33	50

"THE ESSENTIAL THING THE PIPES PLAY" — *Piobaireachd* and the Great Highland Bagpipes of Scotland

By Mitchell Clark

Piobaireachd — the traditional Anglicization of this Scottish Gaelic word is "pibroch" and is approximately pronounced "peebrock"— is a genre of music distinctive to the great Highland bagpipes of Scotland. The word simply means "music of the pipes," or perhaps even more literally, "activity of the pipes." As the sole genre of music included in the "great music" classification of the repertoire of the Highland pipes, piobaireachd is often referred to as the "classical music of the great Highland bagpipes." The "great music" is distinguished from the marches, reels, strathspeys, and the like of "little music" (although this term should not be considered to demean this pan of the repertoire), and is a music solely for listening.

The great Highland pipes utilize three drones (one bass, pitched at A_2, and two tenors, both pitched at A_3) and a chanter (for playing the melody, giving a range of G_4 to A). A reservoir of air is maintained in the instrument's bag, and the Highland pipes are mouth-blown as opposed to bellows-blown, as in the Scottish border pipes or the Irish Uillean pipes. There are often subtle and beautiful variations in tone color from one set of fine Highland pipes to another. The Highland pipes is the form of bagpipes most familiar throughout the world: their popularity in pipe-and-drum ensembles has in some cases eclipsed local forms of bagpipes in places where the Highland pipes have been introduced. This is certainly to be regretted as bagpipes—which are very ancient—have a great variety of forms throughout Europe and into Asia and Africa. Despite the almost universal popularity of the great Highland pipes, piobaireachd, in comparison to the music of the pipe-and-drum ensembles and the solo dances and marches, is practically unknown.

Piobaireachd is a variations form, and although the variation movements it employs are somewhat stereotyped, any attempt at a definition of a typical piobaireachd immediately meets with exceptions. Basically, though, a piobaireachd consists of a theme, called the "ground," with a sequence of standard variations, each more complexly ornamented than the one before, finally returning to the ground. Durations may range a few minutes to twenty or so. The longer examples, commonly of in the range of 12 to 14 minutes, are to be heard in piping competitions. The shorter piobaireachd may include less-standard arrangements of variations, but after hearing the longer piobaireachd, in which a full array of variations movements are included, one is certainly struck that these longer, more involved compositions are the grand examples of the tradition.

In that the only kind of "great music" is piobaireachd and that the only piobaireachd are sets of standardized variations, one might be led to think that the genre lacks dimension and variety. This, as one hears examples of piobaireachd, turns out to be not by any means true. A piobaireachd is a wonderful aesthetic balance of standardized form and the creative construction of variations on that form. In this way it resembles a natural growing thing—a tree, for instance—in a striking way. While the sound of the Highland pipes has a tendency towards stasis—the presence of the drones, the unvarying dynamic level, the constant sounding of the chanter—the piobaireachd form has the tendency towards activity—a grand, swirling activity. In this way, piobaireachd is the ultimate expression of the instrument.

The budding piobaireachd aficionado (such as myself) will have a hard time finding recordings of this music. Available recordings of pipe music are dominated by the solo marches and dances as well as by pipe-and-drum ensembles. Piobaireachd is a specialized taste. Two CD piobaireachd-only collections are *Piobaireachd: The Classical Music of the Great Highland Bagpipe* (Lismor LCOM 9016), which includes performances by five different pipers, and Andrew Wright's volume in the *Pipers of Distinction* series (Monarch CDMON 802). These two are all but one of such collections I've been able to locate,* and I had to go to the College of Piping in Glasgow (by mail, that is) to obtain them. But single piobaireachd may be found together with marches and dances in each of the *Pipers of Distinction* series (the Andrew Wright volume is an exception, being all piobaireachd). The Wright volume, as well as Pipe Major Donald MacLeod's collection *Positively Piobaireachd* (Lismor LICS 5089; cassette only), are of shorter piobaireachd. *Piobaireachd: The Classical Music of the Great Highland Bagpipe* is a collection of the longer piobaireachd, of which there are five complete examples. Each is recorded without fade-ins, which are sometimes used to avoid the sound of the initial filling of the bag with air (this sound is an exciting aspect of the bagpipe' s performance, as far as I'm concerned). The exception on *Piobaireachd* is P/M G.N.M. Stoddart's performance of *The Battle of Auldearn*, recorded live at (I assume) a competition, where the recording is faded in after the player' s opening instrument-testing warm-up.

Of these piobaireachd recordings, *Piobaireachd* is the most satisfying. Having a variety of performers, the recording also allows the listener the opportunity to hear how the timbre of the Highland bagpipes can vary from one example to another. The recordings on the Andrew Wright collection are less satisfying, as they include fade-ins in every case — which may well be to the taste of the recording's producer, or Wright himself—and occasionally fade-outs before the performance is complete. These fade-outs strike me as inexcusable—in such cases the piece and its performance are not being accurately represented.

Archibald Campbell's *The Kilberry Book of Ceòl Mór* (1948;

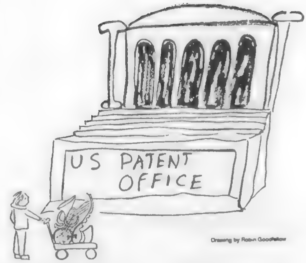
* There is a CD piobaireachd selection taken from the 1990 Glenfiddich piping competition which I have not yet heard. These piobaireachd titles are available by mail from The College of Piping, 16/24 Otago Street, Glasgow G12 8JH, Scotland; they may also occasionally be found at local Scottish import stores in the Bay Area.

6th edition, 1989) states that piobaireachd, which are fixed compositions, are now no longer being composed, or at least that any attempts at composing new piobaireachd are met with scorn by pipers. Elsewhere one finds a less conservative stance, and that new piobaireachd are being met with some acceptance. Again, the stasis of the repertoire implied by the view that all the piobaireachd that are going to be composed have already been composed adds to the sense of timelessness — or of being frozen in time — of piobaireachd, both the music of a piobaireachd itself and the repertoire as a whole. The present writer, for one, has tried his hand at composing a piobaireachd, and despite the standardized, stereotyped variations used in a piobaireachd, composing one is a surprisingly difficult process (although, for one thing, it probably helps to be a piper). The musical and cultural complexities of piobaireachd contribute to its fascinating depth — it is a music unlike any other on the planet.

HISTORICAL MUSICAL INSTRUMENT PATENTS

A Variable-Pitch Tuning Fork

Notes by Bart Hopkin



Be it known that I, Joseph C. Jinkins, of Beallsville, in the county of Monroe and State of Ohio, have invented a new and Improved Tuning Fork.

Thus begins the specification statement of the 1854 patent for the adjustable tuning fork shown on the following page. We present it here as the first in a series of articles on historical patents to appear in this and future issues of *Experimental Musical Instruments*.

According to U.S. patent law, once an idea has been patented, the patent documents enter the public domain. This means that anyone who wishes to do so can visit a patent library, locate any number of interesting and intriguing patents, and publish the texts and drawings, without cost or restriction. (There are, of course, restrictions on manufacturing or otherwise using the ideas covered by patents still in effect). Many writers have had the idea of exploiting this wonderful and conveniently uncopyrighted resource, and so *EMI* is not the first to present a selected patents series — still, I'm confident you'll see things in this collection of articles that you won't see elsewhere.

Digging around in the patent library in search of exciting, promising, or entertainingly frivolous ideas is great fun. The patent library is a treasure trove of information, and a fascinating, if unruly, chronicle of all kinds of human endeavor. Several *million* patents, covering every imaginable sort of enterprise, have been granted since the inception of the patent office shortly after the American Revolution. If you care to investigate this for yourself, there are patent libraries scattered across the U.S. You can find the one nearest you by checking a local large metropolitan phone book, or looking in one or another of the several published books on patenting, or by contacting the Search Room of the Patent Office, Crystal Plaza, 2021 Jefferson Davis Highway, Arlington VA 22202. If there is no patent library near you, it is possible to obtain copies of specific patents by mail or fax, but in such cases it helps to know the patent number of the patent you seek. Browsing from a distance is more difficult. Most larger libraries, however, subscribeto the U.S. Patent Office's *Official Gazette*, which contains summaries of newly granted patents, with patent numbers, dates, and a subject matter index in each issue. Its back issues, going back over a century, provide an extensive historical record.

A valuable resource in this connection is the recently published book, *Piano-beds & Music by Steam: An Index with Abstracts to Music-Related United States Patent Records, 1790-1874*, by Jean Bonin (Berkeley, California: Fallen Leaf Press, 1993. xxii, 236 p. ISBN 0-914913-17-4; see the review in this issue). The book is essentially an index, containing one-paragraph descriptions culled from the specification statements for 1100 patents granted on music-related ideas during the time period described. (No such index exists for music-related patents post-1894, and, with the explosion in the number of patents granted in later years, the project of creating such a thing would be considerably more difficult.) You can seek out subject areas of interest in Bonin's book, obtain the patent numbers, and then order copies of the original patents from a patent library to complete the picture. I will admit to having taken advantage of this book to track down some of the patents we'll be including in this series.

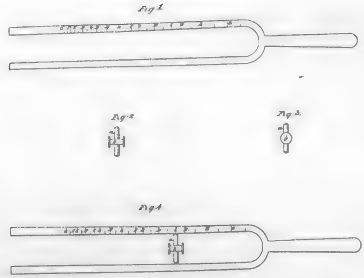
I said a moment ago that this article is the first in a series for *EMI*. I should qualify that by noting that there have often been references to patents in these pages, and we have often had occasion to reproduce information and drawings from patents in whole or in part. An article devoted to the pros and cons of patenting for musical instruments appeared in appearing in our April 1991 issue (Volume VI #6), followed by a sort of travelogue entitled "A Day in the Patent Library" in the following issue (Volume VII #1, June 1991). Recently, in *EMI* Volume 10 #3 (March 1995), we featured Hal Rammel's report, complete with the original drawings, on Grant C. Haium's Alfalfa Viola, patent #2033826, 1936.

One particular piece of historical information is significant in interpreting patents issued at different times in U.S. history. The patent office as first established in 1790 operated on principles similar to, if less sophisticated than, the patent office of today, namely: to obtain a patent, the applicant had and still has to demonstrate the usefulness and the originality or newness ("novelty") of his or her idea. After close scrutiny, if the idea passes muster, a patent is granted to the applicant, offering certain legal rights to the use of the idea. This approach, however, was changed by legislation in 1793, and only came back into effect by further legislation in 1836. Between those years, the obtaining of a patent was (in Bonin's words) "a mere registration process." Patents were routinely granted upon application without regard to the quality or, in some cases, downright idiocy of the idea. The patent was not understood to certify newness of or usefulness. These questions were left to subsequent litigation, in the event that any sort of challenge took place. Thus, a patent granted between 1793 and 1836 is of very different substance from those granted after.

One other legal point to mention: patents hold for a period of 17 years from the date of issuance. That means that the patent holder can take action against anyone infringing upon the patent during that time period. (What constitutes infringement is a sometimes-subtle legal matter.) Thereafter the idea enters the public domain, and anyone is free to take advantage of it. Most of the patents described in this series will be well past their expiration dates, so — have fun.

For the first patent in this series, I've come up with a very simple and modest one. (I did that because I knew I was going to be taking up much of the allotted space with the long-winded introduction you've just read.) It is Joseph C. Jinkins' patent #11566, granted August 22, 1854, for a tunable tuning fork.

The tuning fork, as shown in the drawings and described in Jinkins' specifications, is essentially an ordinary tuning fork with a movable rigid crossbar inserted between the prongs. The fork may be made extra large, to obtain a good tone over a larger compass. The cross bar must fit very firmly, and to achieve this, the prongs of the fork may be bowed slightly inward so that the bar can be forced snugly between. Jinkins also speaks of the possibility of using some sort of adjustment screw to secure it. The fork may be calibrated, with crossbar locations for different pitches marked off along one of the prongs.



Patent drawing for Josheph C. Jinkins' Improved Tuning Fork

BOOKS

BOOK REVIEWS

by Warren Burt and Bart Hopkin

TREVOR WISHART: AUDIBLE DESIGN: A PLAIN AND EASY INTRODUCTION TO PRACTICAL SOUND COMPOSITION

Book, CD, and two accompanying booklets. £30 (UK), £35 (Europe), £38 (the Americas), £40 (Japan, Australasia) from Orpheus the Pantomime, 83 Heslington Rd., YORK YO1 5AX UK, (Checks in British Pounds should be made out to Orpheus the Pantomime, Ltd, and be payable on a bank with a London Office); or $65 US (for UK); $70 US (for the Americas and Europe); $75 US (for the rest of the world) from Electronic Music Foundation, 116 North Lake Avenue, Albany, NY 12206 USA.

The computer, of all experimental musical instruments, is the one that offers the most possibilities, and yet often remains the most inaccessible. This inaccessibility results from a number of factors: the price of the beasts, the lack of usable software for them, and the lack of suitably musical interfaces to control them. It should also be stressed that the computer is probably still in, if not its infancy, no more than its early adolescence. Even the most supercharged Pentium or Power PC can still be maddeningly slow when asked to do some of the more computationally intensive operations like time-stretching, or complex digital filtering.

Things are slowly changing, however. Computers are gradually getting more powerful, their prices are going down (but not as fast as most of our incomes!), and usable software is becoming both available and affordable. (A good example is the software from the Composers Desktop Project, based in York, England, with which were made most of the sound examples on the CD accompanying the book under review here.)

Now English composer Trevor Wishart has published *Audible Design*, a guide to just about every kind of sound modification that can be done with a computer. This book is a follow-up on his 1985 book *On Sonic Art* (also highly recommended!), but can easily be read independently of it.

Audible Design is an admirable and important book. Its focus is sound, in all its aspects, not just pitch and rhythm. As Wishart says, his intention is not to duplicate the history of Western musical theory, but to deal with all aspects of sound, and ways that the computer can be used to manipulate them. Most of the techniques that he describes are, at the moment, limited to non-real time processing, but that will eventually change. Even for those dedicated exclusively to real-time performance, this book will contain a wealth of information.

Some of the most useful information in the book describes the ways sound can be changed by operating on Fast-Fourier Transforms (FFTs). This is a technique where the spectrum of a sound (which frequency components of the sound are loudest and softest) is analyzed, in each of a number of very short segments. A 1/2 second sound, for example, might be divided into 90 segments, the spectrum of each of which might be analyzed into, for example, 256 frequencies. The result of this operation is a list of numbers, each of which describes the relative loudness of a particular frequency at a particular time. When run back through an operation called an Inverse Fast Fourier Transform, these numbers can be turned back into sound.

But since the FFT is just a list of numbers, if you know what the numbers mean, all sorts of interesting changes can be made to them, by extremely simple means, producing unique results. For example, if you decide that only the very highest numbers in an FFT will be preserved, all the others being turned into zeroes, what you will have done is filtered out all the partials of a sound except those which were the loudest at any moment. If this is done to a sound that varies in time, such as speech, the result will be "melodies" of harmonics which follow the content of the original sound, but which sound quite different from it. This technique, and many others, are described clearly and simply in Wishart's book, and are illustrated by the sound examples on the CD and the booklet of diagrams.

This is not so much a book, as it is a package: the main book, a 111 page text set in annoyingly tiny type (in fact, my only criticism of the book is its hard to read typeface!); the CD; and two booklets, one of which describes the contents of the several hundred sound examples on the CD, the other containing 73 pages of diagrams expanding on material in the text. In going through the material, you'll want to have all of these available, as each paragraph or section of the text refers to both a diagram and a sound example.

This is not a book to breeze through, but one which requires

close study This is not because the text is written badly; in fact, the writing is admirably clear and easy to understand. Wishart has the ability to make complex subjects clearly understandable. But the writing is dense. Each paragraph deals with yet another way the computer can be used to modify sound. And each page contains about three ideas for pieces — at least it did for me. The separating out of texts and diagrams was also a good idea. The diagrams booklet on its own is a quick refresher course in the physics of sound. The diagrams were so clear that even a computer idiot like me was able use them as the basis for writing small programs to try out some of the ideas suggested. (And, as an irreverent aside, sampling maniacs will want to have the book not only for what it says, but also for the CD, which contains some of the best material for illicit sampling I've ever encountered. I can already hear samples from this CD potentially infesting raves the world over!)

In short, if you're interested in finding out about the sound possibilities of computers today, you should get this book. I think it's the best book since Henry Cowell's 1919 *New Musical Resources* that clearly gives the possibilities of a new musical and sonic universe.

—WB

JEAN BONIN: PIANO-BEDS & MUSIC BY STEAM: AN INDEX WITH ABSTRACTS TO MUSIC-RELATED UNITED STATES PATENT RECORDS, 1790-1874

Published in 1993 by Fallen Leaf Press, Berkeley, California.

This review is reprinted from *Notes: Quarterly Journal of the Music Library Association*, March 1995, by permission of the Music Library Association.

The United States Patent Office and the patent libraries scattered across the country comprise an unmatched repository of technological information. Some of it is monumentally important, and some amusingly trivial. The several million U.S. patents granted over the last two centuries represent a unique record not only of technological innovation, but also of a particular kind of human fantasy, hope and ambition.

In *Piano-beds & Music by Steam*, Jean Bonin lists all U.S. patents relating to music issued between the creation of the U.S. patent system in 1790 and the publication of the patent office's first subject matter index in 1874. In that time 156,000 patents were granted. Bonin finds among them a total of 1100 music-related patents. Records for some of the earliest patents were destroyed by fire in 1836; beyond that, Bonin's listing is exhaustive and complete. No one has endeavored to provide what would logically follow this book — a listing of music-related patents post-1894 — no doubt because, with the explosion in the number of patents granted in later years, the project would be hugely unwieldy.

Several authors have created books or articles by digging through the patent records in search of interesting or entertainingly wacky patents, and re-publishing them with or without comment. Despite its catchy-sounding title, **Piano-beds and Music by Steam** is not one of these books. Bonin's book is designed as an exhaustive listing and index. The researcher will want to look here to find patent numbers for patents on topics of interest, and then seek out the original patents for further information.

The large number of patents listed allows for only the most cursory description of each. To create a brief abstract for each invention, Bonin excerpts from the inventor's specification statement in the original patent, to create a one-paragraph description of the idea. Since the original specification statements are typically much longer, Bonin had to do some careful culling to create these more concise statements. The task of providing adequate descriptions in a brief paragraph is a difficult one, and Bonin's decision to retain the inventor's words, however edited, was probably a wise one. But with the brief abstracts appearing here it is sometimes difficult to determine which patents are most worth pursuing in connection with a particular area of research. On the plus side, the peculiar linguistic constructions that permeate modern patents are not much in evidence here: while the language may be stiff and formal in the style of the times, the applicants generally describe what they have made in a reasonably straightforward manner.

Along with the abstract, each entry includes the inventor's name and city of residence, the date of issuance and the patent number. Bonin also provides a separate index of inventors' names, a geographic index of inventors' locales, and (especially important) a subject index. Bonin's fifteen-page introduction opens with an overview of trends in patenting, with references to several colorful, important, or representative patents of the time. Brief historical information on the patent system follows, including important information on changing legal procedures. It ends with notes on the author's methodology in researching and presenting the information.

And what sort of musical inventions do we actually find here? I must confess, I found a bit less diversity, and less unfettered imagination, than I had expected. There are a great many improvements to piano actions, and a lot of variations in key-action and wind-chest design for the harmoniums that were then popular. There are several automatic page turners, improved piano stools, and piano locks. There are octave couplers and transposing devices for keyboards, and tremolo devices and swells for organs and harmoniums. There are simplified notation systems (shape-note was just one of many such), and diverse pedagogical aids. More fun (to my way of thinking): there are various sustaining pianos, employing coupled reeds, bowing devices, or repeating hammer actions. There are instruments with piano-like action sounding idiophonic elements including bells, gongs, tuning forks, lamella and the like. There are advances in mechanical instrument actions and data storage systems. There are ideas (some questionable) for improving the resonance of soundboards in various instruments. As the book title suggests, there are various attempts to build musical instruments and large furniture pieces into a single unit.

One omission will diminish this book's usefulness for many readers: Bonin does not provide a map to make it easy for novice readers to find their way to the original patents. A single paragraph letting people know of the availability and accessibility of the wonderful resource that is the patent library, coupled perhaps with a listing of such libraries with contact information, would have been a valuable democratizing gesture without requiring much in the way of additional space or research.

I have raised a few objections here, many of which represent difficulties inherent in the task at hand more than flaws in the author's work. I, for one, am glad this book came into being, having already found its information useful on several counts.

—BH

THE LESKOWSKY COLLECTION

By Daróczi Kiss Márta

Photos by Walter Péterné

Translated by Coventry House Kecskemét

In the middle of Europe, in a town of about 100,000 inhabitants, there lives a fantastic person, Albert Leskowsky. His professionalism and his mania for collecting has helped him to establish a great and very unusual collection of over 1,000 musical instruments.

Leskowsky has an eccentric personality. He has gathered his knowledge through his special communication skills, his interests in many fields, his talent, his rich experience and sudden changes and adventures during his career. This real-life knowledge made him capable of establishing and categorizing his collection and then advertising the collection successfully to the public. He has also acquired the art of making new musical instruments.

His love for music started some time ago when he was working as a technician for the Fonográf Group. In addition to modern styles, he started to be interested in Hungarian and foreign folk music. He met young and elderly folk musicians and instrument-restorers, who let him have an insight in the secrets of making instruments. He was a regular customer at flea markets and auctions. He also attended courses about the history of music and read books on the same topic in German libraries.

The home of the Leskowsky Collection

He visited an exhibition of folk instruments in the seventies in Kecskemét, after which he decided to set up a collection. By that time the walls of his flat had already been decorated with different instruments, some of the instruments donated by friends, and others bought himself.

In 1977, for the first time he displayed a part of his own collection at an exhibition. The exhibition was supported and opened by a well-known professional. Since that time, Leskowsky has continued the traditions of sharing his collection with the public. He seizes every opportunity to educate, spread the information and make the whole thing popular to the public, especially for young people. After some time he realized that the only framework, that could make it possible for him to display his favorite instruments through the year was a museum. He decided to take up a job as a museum assistant as a first step. Later on he "climbed the ladder" as a guard, then later became a guide.

In 1979, he offered his collection to the town of Kecskemét for a minimal sum. In return he asked that the council guarantee the appropriate environment and conditions for his collection.

During his travels he focuses on finding new and valuable pieces for the museum. He constantly takes lessons from old masters to learn how to play the different instruments. He organizes music groups and plays himself. He initiates experiments, where he joins the different fields of arts. He encourages artists to create pieces like collages, panel pictures and sculptures which reflect the parts of instruments and their sound-making character, or being independent designs, represent special "instrument-mutants". He usually buys these creations for his collection and puts them on permanent display in spite of the criticism of some conservative professionals.

At Leskowsky's exhibitions, he creates performances which are full of new and witty ideas, and usually have a high-quality musical background. These events are an essential part of the cultural life of the town.

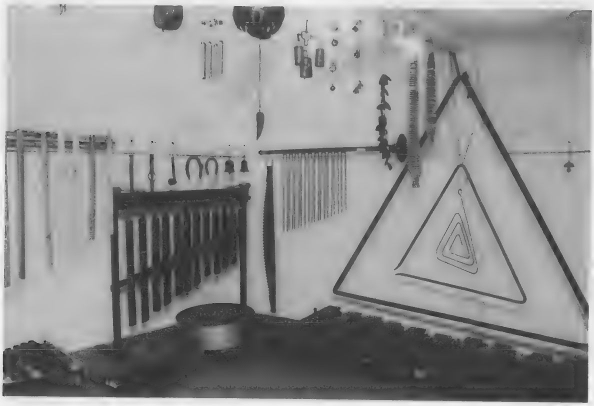
He and his musician friends, every so often, are invited to perform for TV and radio programs. He had the same support when he made his first LP.

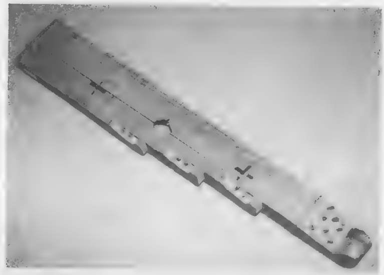
On 30th March 1993 he was able to open his relocated collection to the public on three floors of a restored house. The instruments are categorized according to their types, and age. The folk music of a lot of countries of the world is represented there by both classical and folk instruments. They are accompanied by the new constructions, the instrument-hybrids, and by the specially assembled noise-making instruments, which can be considered as movable sound sculptures.

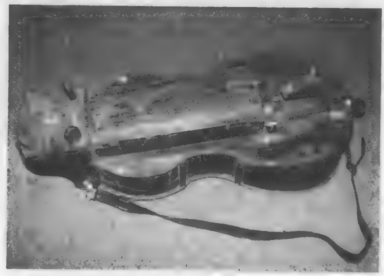
The collection also includes electric instruments of our country, and other equipment for transmitting sound and music.

The museum attracts a lot of visitors. Apart from viewing the objects, they can also enjoy short concerts given by the people working there. The visitors themselves can really experience some of the instruments by playing them.

The museum is situated in Kecskemét, in Kodály's native town, where you can find several other musical institutions, museums and artistic workshops, thus enriching the cultural life there.







Photos this page:

HISTORICAL, FOLK AND ONE-OF-A-KIND INSTRUMENTS IN THE LESKOWSKY COLLECTION

Upper left: Bowed instruments

Lower left: The percussion room

Upper right: A guitar from the 1890s

Middle right: Hungarian citera

Lower right: Hungarian tekerölant (hurdy gurdy)

Photos on facing page:

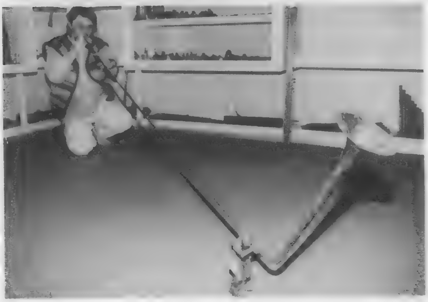
INSTRUMENTS MADE BY ALBERT LESKOWSKY

Top: Trumpet

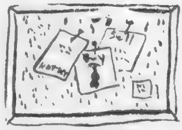
2nd from top: Horn

3rd from top: Percussion

Bottom: Cycle



Unclassified ads here in EMI's notices column are free to subscribers for up to 40 words; 40¢ per word thereafter. For others they are 40¢ per word, 15 word minimum, with a 20% discount on orders of four or more insertions of the same ad. On the other hand, you might be surprised at how affordable a display ad is in EMI: $60/half page, $40/quarter page, $25/1/8 page. Write or call for details: EMI PO Box 784, Nicasio, CA 94946; phone/fax 415/662-2182.



WAYLAND HARMAN'S CLACKAMORE — "THE WORLD'S NEWEST PERCUSSIVE MELODY INSTRUMENT." Clackamore $23.00 ppd, PVC case $6.00 ppd, instructional video $20 ppd. PO Box 6444, Boise ID 83707. THE CLACKAMORE — A TOOL FOR LISTENING TO THE SHAPE OF YOUR MOUTH. [11-2]

The 1995 Zimbabwe Music Festival takes place at the University of Washington in Seattle, November 10-12, 1995, featuring performances, workshops, community events and exhibits. For information write Zimbabwe Music Festival, PO Box 22760, Seattle, WA 98122-0760, or call (206) 517-7715.[11-2]

Catacombs of Yucatan Sound & Video Installation will transform a limestone cave into a living instrument of light and sound. Oct. 7-8 1995, 10AM-5PM, near Yucatan, Minnesota. For information call (507) 896-2219. [11-2]

Mathematical Models of Musical Scales: A New Approach, by Mark Lindley and Ronald Turner-Smith. A 300-page, hard-cover book, new from Orpheus, Verlag GmbH, Verlag für systematische Musikwissenschaft, 53129 Bonn, Eduard-Otto-Str. 41, Germany. [11-2]

Thoreau's Aeolian Harp music as he heard it at Walden Pond. Tape cassettes of the music from this harp accompanied by songs of the wood and hermit thrushes. Harp reproductions of his own design available in Walnut. Ken Turkington 1-800-692-HARP. [11-2]

The Hawaii Bamboo Conference takes place May 25-27 1996. For information contact Richard Waters at PO Box 1071, Pahoa, HI 96778, phone (808) 965-0955; e-mail bamboomuse@aol.com. [11-2]

The Power of Sound: An 8-month program focused on the transformational and therapeutic applications of music and sound, from the Institute for Music, Health & Education. Classes meet four weekends. Programs in California and Maryland this fall and spring. For information call (800) 490-4968. [11-2]

CALL FOR PAPERS: The American Musical Instrument Society will hold its 25th annual meeting at the Shrine to Music Museum, University of South Dakota, Vermillion, May 16-19 1996. Papers exploring important themes in current musical-instrument scholarship will be presented. Proposals for papers should be received by November 15, 1995. For information, contact John Koster at The Shrine to Music Museum, 414 East Clark St., Vermillion, SD 57069. [11-1]

Multi-instrumentalist/composer MARK WHITECAGE offers "Watching Paint Dry" cassette featuring his sound sculptures, horns, compositions with Rozanne Levine, Joe Fonda, Mario Pavone, Gerry Hemingway. $12.00 includes postage, check/m.o. payable to "Mark Whitecage" c/o acoustics, 406 Washington St., Hoboken, NJ 07030, tel/fax (201)798-2166. [11-1]

BROADCASTATIC WVCW 640 AM / 105.3 Continental Cable FM: Experimental music radio show featuring lo-fi, free improv, electronic, and other sound experimentation. Please mail contributions to: TOMMY / PO Box 7222 / Richmond, VA 23221. [11-1]

Earthshaking Percussion: Djembe, Talking Drums, Didjeridu, Dumbeks, Typan, Frame Drums, Surdo, Pandiero, Tabla, Cajons, Clave, Angklung, Balafons, Clay Pot Drums, Kanjira, Bodhran, Sitar, Harmonium, Shekere, Slit Drums, Caxixi and much more. Call (404) 624-3349 for free catalog & color photos! [10-4]

I make a variety of unprecedented electric kalimbas, paperback sized, solid-body bass rumba boxes, Indonesian pentatonic phase pulsars, and the amazing "Graphic Buzzalizer," that turns anyone into Jimi Hendrix! Info & prices — Generalissimo Kalimba, 535 SE 70th, Portland, OR 97215. [10-4]

Build a custom MIDI Controller/Instrument in one night! — PAVO introduces the MIDItools Custom Instrument Kit, allowing you to create a one-of-a-kind MIDI controller. More information: PAVO, 10 S. Front St., Philadelphia, PA 19106, USA; (215) 413-2355. [10-4]

Having made their living solely on the performance of their multimedia concerts, installations and lecture/demonstrations for the past eleven years as The McLean Mix, Barton and Priscilla McLean are announcing for the first time a tour bringing them to all parts of the continental USA during the winter-spring 1996 season with a choice of 17 different programs. Call Barton at (518) 658-3595 for info. [10-4]

Incantors — Q.R. Ghazala has recently bought out another small inventory of brand new and increasingly rare Texas Instrument Speak & Maths. These devices are the heart of the most deluxe and best sounding incantors to date. Price is $240 (reflecting only parts plus bench fee at repair shop hourly rates). Finished instruments are fluorescent green and gold. Controls include looping, speed/pitch dial, milk glass and brass electric eye (sequences loops with a wave of the hand), body-contacts for inter-flesh modulation, envelope LED, three voice-bending switches and reset switch. All incantors include blue fluorescent alpha-numeric display, monitor speaker, line output, custom patch cord, and instruction sheet. Amazement guaranteed. Owners consider the INCANTOR to be the ultimate experimental music box. For more information, see the INCANTORS article in EMI Vol VIII #6, June 1993, or write to Reed at Sound Theater, Echo 241, 7672 Montgomery Rd., Cincinnati, OH 45236, USA.[10-3]

A book by Bart Hopkin, editor of Experimental Musical Instruments, has been published by Lark Books. *Making Simple Musical Instruments: A Melodious Collection of Strings, Winds, Drums & More* is a collection of plans for home-buildable musical instrument, ranging in difficulty from simple to moderate. Most of the instruments relate closely to familiar instrument types and are playable as such. Yet even experienced experimenters will find some new ideas here. It's hardbound, with 144 big and very full pages, lots of color, beautiful photos & illustrations; price $24.95. Order from Experimental Musical Instruments, PO Box 784, Nicasio, CA 94946, USA, phone (415) 662-2182. 10-4]

AIR COLUMNS AND TONEHOLES: PRINCIPLES OF WIND INSTRUMENT DESIGN is a spiral-bound booklet containing the four articles on practical wind instrument acoustics by Bart Hopkin that appeared in EMI in 1992 and 1993. The articles have been much revised and improved, and there are several additional features included. Published by Tai Hei Shakuhachi; available for $12.50 (no additional postage required) from Tai Hei Shakuhachi, PO Box 294-C, Willits, CA 95490, or from EMI, Box 784, Nicasio, CA 94946. [9-4]

SUBSCRIPTIONS TO EMI: $24/yr for U.S.; $27/yr for Canada & Mexico; $34/yr overseas. California residents add 7.25% sales tax for a total of $25.74. Order from EMI, Box 784, Nicasio, CA 94946, USA. Visa/MC accepted.

EMI BACK ISSUES: Bound volume sets Vol 1 through Vol. 10: $17 per volume. Each volume set contains all of the issues of one volume year, photocopied and bound under one cover. The photocopies are a step down in quality from the original press runs, but they are readable still. The price includes postage for U.S., Canada & Mexico air, and overseas surface rate. For overseas air add 20%. In California add 7.25% sales tax. Order from EMI, PO Box 784, Nicasio, CA 94946, or write for a listing of back issues and their contents. Corresponding cassette tapes are available for later volumes; see information below.

CASSETTE TAPES FROM EMI: Each cassette in the EMI cassette series contains music of instruments that appeared in the newsletter during the corresponding volume year, comprising a full measure of odd, provocative, funny and beautiful music. Volumes 6, 8,I9 and 10 are available (other volumes are now sold out). The price is $8 per cassette. This includes postage for air delivery in the U.S., Canada and Mexico, or surface delivery overseas. In California add 7.25% sales tax. For overseas air add $20%. Order from EMI, Box 784, Nicasio, CA 94946. Visa and Mastercard accepted.

FROM THE
MUSIC WING
OF THE
— DREAM MUSEUM —

SKY HARPS

D.R. Ghazala

It's known that in the days when Jell-O talked, and was made to look through rather than eat, immense sky harps occasionally appeared in our midst. It was not unheard of to have, say, a picnic in the woods interrupted by a drifting harp arm. First the sound, like a distant swarm of bees, could be heard mingling with the song-birds in the wind. From the direction of that noise a breeze would then rise and carry away the sparrows, grown silent, into the secret shadows of the trees. An oracle was coming.

Blades of grass, perhaps, from a neighboring meadow, and a mushroom or two might gently rain down, souvenirs of the harp's nearby travel. Then, at clearing's edge, the boughs would suddenly buckle under the pressure and swiftly fly back as the ray swept in, a brilliant rod of opal glass towering from earth to sky. Caught in the sunlight, the air seemed to tremble as though held in place by the intricate drone everywhere. Like to a dust devil, leaves tumbled into the ray's base and climbed in odd spirals up the wandering beam, disappearing through the branches overhead. And then off, brushing back supple limbs in its way, beehive buzzing it departs by its own path and gait, absorbed once again by the forest...

DRG

From the Music Wing of the Dream Museum: SKY HARPS

By Q.R. Ghazala

(continued from preceding page)

Of all the fanciful, little-known musical instruments of the atmosphere ...cloud choirs, harmonic glories, musical rainbows, singing sun dogs, operatic winds, solar "green booms", pitch bubbles, frog dusk, sun pillar hum, star giggle, note flocks, rain sirens, snow drums, even cyclone organs ... none inspire as many questions as those raised by the towering sky harp, piercing land and cloud-top at once.

Where do sky harps come from? What are they made of? Who or what creates them? Are they *meant* to be musical instruments? What of the strange related phenomena? Where are they today? To address these questions, I submit the accompanying rare and extraordinary illustrations which, when viewed through Jell-O, will appear 3-D and may be attended by a wobbly narrative voice.

Indeterminate pitch as well as general physical shape will immediately tie the sky harp to the orchestral triangle, whose history is fairly well known. Adapted from Turkish Janissary bands, the early European musical triangle is depicted in the stained glass of the 13th century Leon Cathedral, though the instrument did not come into general usage until after 1300. An early 14th century Flemish Book of Hours depicts the triangle player holding a pair of lighted candles at the ends of a board clenched between the teeth (symbolic of the sky harp's glow?) In the mid 14th century stained glass of The Lady Chapel of Ely Cathedral we see an early English representation of the triangle. Here, as was common at the time, the instrument was stirrup-shaped and closed at the bottom by a bar to which bells or jingles were attached. During the mid 1600s, Marin Mersenne, French mathematician and philosopher, refers to the triangle in his **Harmonie Universelie** by the name *cymbale*. A couple decades earlier than that, Michael Praetorius in his **Syntagma Musicum** provides us a bit more substance with the title "*crotalum*, vulgo ein Triangel." The familiar triangle of today entered orchestral scores in the 18th century, affording a valuable new sound that, despite the instrument's diminutive size, was capable of being heard above the full orchestra due mainly to its complex and indefinite frequencies. Among many others, Haydn, Schumann, and Beethoven wrote for the meek triangle, recognizing the power of its almost renegade voice.

Beyond tone and shape, the history of musical instruments reveals other increasingly esoteric parallels between the sky harp and more earthbound designs. Ringing instruments meant to be heard and seen above the head, or against the

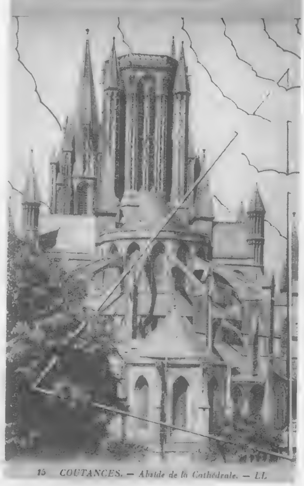


Figure 1 (upper left): Typical sky harp being examined by townsfolk. It appears an attempt is being made to reposition from before entrance way.

Figure 2 (lower left): Unusual sky harp in that it remained somewhat fixed in position for 3 days. Both tenant and shop owner broke their leases.

Figure 3 (upper right): Another fixed sky harp. Though neighborhood cats gathered to listen each night, there reportedly were no fights.

Figure 4 (lower right): Atmospheric disturbance and unusual cloud formations often accompany sky harps. A fine rain fell

sky, are found in the records of cultures worldwide. Two early representations of *elevation bells* are seen in Bonanni's 18th century **Gabinetto Armonico**, first published in 1723 and centering around a collection of Arnold van Westerhout's lovely engravings (see plates 123, 163, next page). In Syria, these symbolic bells were rung during mass to signal the Elevation of the Host. From modern carillon to ancient bull-roarer, it seems something has inspired us to elicit voices from above.

Could sky harps of pre-history have influenced our species as objects of awe, even deification? Or as deliverers of technical and philosophical inspiration? Trichotomies are assumed all around us. We have the human identifiers of body, soul, and spirit. Religious trinities abound, two better-known examples being Christianity's Father, Son, and Holy Ghost, along with Hinduism's *Trimurti* of Brahma, Vishnu, and Siva. In fact, the superstition of bad luck befalling anyone walking through the triangle of an open stepladder finds its origin in the belief that such an act would symbolize a violation of the Holy Trinity. This ill deed promised disaster unless, oddly enough, the perpetrator was willing to keep the fingers crossed until next seeing a dog. (Figures 2 and 14 may tie-in here.)

Did the shape of the sky harp suggest material usages to early man? Connections to the pyramid are obvious, and the triangle is not entirely lost upon the noble arch, the vaulted ceiling, or the flying buttress. Architecture is rife with structural triangles of all types, lending perhaps a poignant family portrait touch to figures 2, 3, and 7.

So what is the origin of sky harps? Theories of dimensions parallel to ours, dimensions that actually occupy the same space but exist at alternate temporal wavelengths, have been forwarded in an attempt to visualize the cause of various unexplained phenomena. Do sky harps share their proper world with the luminous bubbles, glowing sky bands, or UFOs occasionally seen on our plane? Even so, do sky harps slip into our reality by accident, or are they placed here purposely?

Unanswered, also, is the largest question: What is a sky harp? Because of the sky harp's shape and sound, the suggestion of an immense musical instrument comes quickly. But could it be that the voice of the sky harp is coincidental to its primary function, perhaps entirely unrelated to music? Could the temporal resonance of dimension-slipping actually set-up the vibrations at the source of the sound? Could the occurrence discussed with figure 6 indicate a signal or code transmitter of some outrageous type? Would sky harp appearances over historic, technological, and significant geologic sites indicate surveillance devices of some kind? In appearances such as those captured in figures 3, 9, 10, and 12 it would seem a multi-species IQ enhancer may be at work. Or could the sky harp phenomenon be a positionable portal between two or more coexistent worlds, as hinted by the circumstances of figures 5 and 12?

Equilateral, isosceles, right, obtuse, scalene ... the sky harp can assume any triangular form. Ray luminosity may be due to a piezoelectric reaction known as triboluminescence, light resulting from the compression of certain solids or entrained gasses within liquids. Mysterious

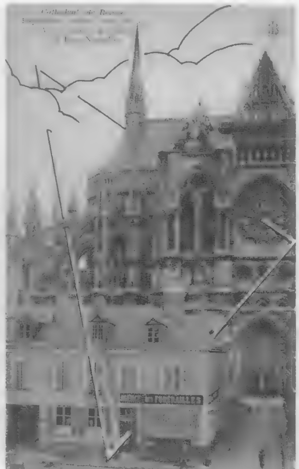


Figure 5 (upper left): Interference in space/time relationships are common in the midst of a harp event.

Figure 6 (lower left): Several audio recorders caught the pitch cluster of this appearance. All recordings, however, have gradually faded over the years into the Monkees theme song.

Figure 7(upper right): Places of worship and funeral agencies alike often fare well after a sky harp appears. One cannot be sure to which the foreground figure is rushing.

Figure 8 (lower right): Ray/water junctions are unpredictable. In this instance fish fed from the underwater beam, it having turned to green cheese.

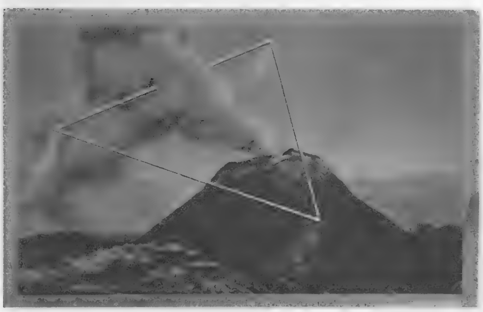
Figure 9 (upper left): Stringed instruments within the chateau sang along with this sky harp, and songbirds in the vicinity imitated the harp's voice for several months afterward.

Figure 10 (upper right): Children have the ability to move sky harps. The lad pictured became a singing 4-D geometry professor.

Figure 11 (lower left): When volcanic ash crosses harp rays, a sweet blue snow falls from the harp's apices.

Figure 12 (lower right): Over 300 persons standing under this harp disappeared, only to re-appear at 1:00 AM, all newly able to make fine insect noises.

Left: Engravings numbers 123 and 163 from Fillipo Bonanni's *Gabinetto Armonico*, first published in Rome in 1723. Reprinted by Dover in 1964.



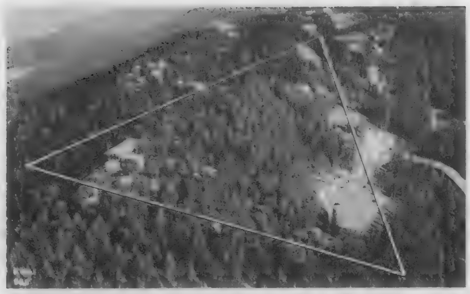


Figure 13 (above left): A low, horizontal, equilateral sky harp. After settling into this Finnish bay, the glowing harp spun under water all night.

Figure 14 (above right): A harp ray protrudes upon the Casa Petrarca. All dogs thereafter fled the room if anyone within crossed their fingers.

patterns of light in the sea ... radial bursts, travelling bands, spinning geometric shapes, the *te lapa* of the Pacific Islands ...may indicate that sky harps are as ocean-going as they are airborne.

Perchance, rather than vibration of the three rays, the indefinite pitch of the sky harp is due to the excitation of a *dimensional barrier* stretching between the floating arms, a trembling skin of temporal tension separating two worlds. Then again, perhaps they are simply alien triskelia of sorts, soaring icons of otherworld symbology, crop circles of the air.

Whether reflection or genesis of our science, religion, and philosophy, doorways to neighboring worlds or wondrous works of art, the sky harp remains a beguiling and gelatinous mystery of the Sound Theater Museum. Enigmatic and ephemeral, sky harps still drift among us. Though seldom seen, today's harps are much more numerous, refined I suppose, and markedly streamlined. While barely visible, with just the right light the harp's rays might appear as a gossamer thread, a single, taut spider silk floating through the air. In the rush of our current world, in fact, sky harps might be lost altogether were it not for the telltale "ringing in the ear" that each one of us has heard as the ray slowly sweeps by.

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Reed Ghazala can be contacted through: SOUND THEATER, Echo 241, 7672 Montgomery Rd., Cincinnati OH, 45236, USA.

See the Sound Theatre World Wide Web site at:
http://www.iac.net:80/~cage/reed.html. Audio-visual instruments gallery, one-of-a-kinds available, music catalog, multi-disciplinary portfolio, and very much more. *Architexture:* Cindy of the caterpillar byte.

RECORDINGS REVIEWS

By Sasha Bogdanowitsch, Mitchell Clark , Bart Hopkin and René van Peer

THE HUB: **WRECKIN' BALL**

On CD from Artifact Recordings ART 1008. 1374 Francisco Street, Berkeley, CA 94702

MARK TRAYLE: **ETUDES AND BAGATELLES**

On CD from Artifact Recordings ART 1010. Address same as above

CHRIS BROWN: **LAVA**

On CD from Tzadik TZ 7002. 61 East Eighth Street 126, New York, NY 10003

The computer has become a household tool, it determines to some extent how we view and shape this world that we live in. Also hit movies such as *Jurassic Park*, *Forrest Gump* and *The Exterminator* derive part of their success from computer-processed animation. Virtual reality environments attract much attention. Somehow computer music seems to lag behind, as if it cannot overcome the barrier of hermetic technocracy.

For anybody who has once visited a concert by computer network The Hub it is clear that such music can indeed be entertaining and open. Moreover, the activities on stage — even when they involve keyboards, mice, monitors and a lot of wire — strike one inevitably as social. The musicians audibly influence each other's programs, they respond to each other's actions. One example of this is when one person's input has come to a level where its contribution to the whole is running by itself; he raises his hands and sits back. In the end all may keep their hands off ongoing musical events that now have acquired a life of their own, until each starts to disentangle this mesh by withdrawing their various threads.

Wreckin' Ball, their second CD, is a next step in the development of human computer music. From one side it is and remains computer-generated, meaning that sounds arise and change through complex rules. A large part of the sound events cannot possibly be made by plain human playing but appears to grow exponentially from relatively simple actions. Still, the music of The Hub is also man made. Decisions in it are clearly made with aesthetic aims in mind. Cooperation and social interaction are evident. Moreover, all music on this CD was recorded during concerts. Often you'll hear the room where they played, and on some tracks musicians who joined them on acoustic instruments. This makes the music really come alive. In fact, The Hub never sounded more like a rock band. Although their music can only exist on account of sophisticated technology, they have successfully shifted attention away from that to focus on the joys that making it and listening to it can bring.

Mark Trayle, one of the Hubsters, has for some time been working with a dataglove to trigger and process samples. This glove comes from virtual reality applications where its position and movement, and certain manipulations performed with it are translated into events in the computer generated image of an environment. It's probably best described as a three dimensional mouse. In "Seven Gates," the main piece of his CD *Etudes and Bagatelles*, Trayle has fine tuned its musical application. In an explanatory diagram on the insert he represents the operational space of the glove as a toolshed with shelves behind a gate on the far end. With the glove Trayle can pick up samples stored on these shelves, take them through the gate into the playing area where he tosses them around, chops them up and mixes them.

He has arranged the material in this piece symmetrically into seven parts, using three sources for his samples — Norteña music, 18th century orchestral compositions and spoken word from radio and television. Trayle's choice proves to be sensible. These groups of samples are not just distinct, they complement each other. The first is full of bouncy rhythms, in the second smooth chords predominate, the third combines a limited tonal range with uneven rhythm patterns. In the central section they are mixed together into a hybrid, effectively making a new species of music evolve. Another event well worth hearing is a loop of this 18th century music, so short that it sounds like a steel drum.

Chris Brown, another member of The Hub, takes a different direction in *Lava*, an hour-long piece for brass, percussion and electronics. Composed in 1992 it was only released on CD earlier this year. It addresses a characteristic that is basic to live electronic music — a constant state of transformation. Whereas in concerts of The Hub this gives the music an improvised air, Brown has managed to devise a framework that makes the piece feel at once fluid and fixed. Quite fittingly this two-phase scaffolding is related to time and tempo.

As the title indicates the imagery is derived from volcanic activity, especially the movements of and within a lava flow until it congeals. On the one hand Brown has translated this to tempi that accelerate and decelerate, or to simultaneous layers that each have a different though constant pace. On the other hand the liquid and the solid phase are represented by sound properties of percussion and brass respectively; Brown's live processing of these acoustic sounds (he doesn't use synthesizers or pre-recorded samples in *Lava*) functions as an intermediary between the two.

In fact that equation is only one of the levels on which this sound-geography imagery works. The real complexity of this piece does not lie in the music or the compositional structure. The map of tempi is a wonder of clarity. The sound is transparent. There are no cryptic references within the music. Melodic lines do not require superhuman skills. The complexity lies at the core of the piece — the various ways in which Chris Brown has managed to translate the character of a lava flow into sound events that, layered over each other and strung together, form one continuous whole.

What I find astonishing and deeply gratifying is that this CD made me feel like listening to lava. Often the brass simply glows with incomparable brilliance; tuba and trombone sometimes grumble and burble like thick hot mud from which steaming bubbles escape. Across the blazing river currents run at different speeds. Now and again the flow halts momentarily, as if checked by a sudden obstacle. The overall impression is of a simmering, shimmering motion — as fascinating to listen to as running lava must be to watch.

In concert the sounds are fed to a four channel system that surrounds the audience. The effect must be dazzling and tantalizing, drawing the listener into a realm of unusual beauty. Propelled by The Hub Chris Brown seems to have made a significant step. Listening to electronic music I generally find it difficult to get beyond the artificiality of the sounds and their being derived from existing sources. *Lava* overcomes these obstacles, easily and convincingly.

Artifact Homepage on WWW —
http://www.mcs.csuhayward.edu/~timper/a/index.html

—*RvP*

FREDERIC LE JUNTER & PIERRE BERTHET:
PIERRE BERTHET & FREDERIC LE JUNTER

On CD from Metamkine Vand'oeuvre 9407. 13 rue de la Drague, 38600 Fontaine, France. In North America distributed by DIFFUSION i MeDIA.

The instruments that Frenchman Frédéric le Junter builds look and sound remarkable. The collection he has built until now constitutes a

coherent body of odds and ends, informally constructed flotsam and jetsam. Possibly this is the logical result of having gone through some classes of a college for design and living in an old Dutch-speaking enclave on the French coast. To play these contraptions Le Junter has teamed up with Pierre Berthet, a Belgian musician and builder of percussion installations in which water drops provide the principal sound. This CD is a showcase of the eddies and torrents fed by the meanderings of Le Junter's mind on its course to realize his intent, and of Berthet's rather more tranquil approach.

The first part of the album consists of short pieces that dangle to and fro between frantic rock songs and chansons one could expect to hear in a sailors' bar on the far edge of sanity and sobriety where lines suitably run, "nothing looks like nothing." Le Junter's boisterous vocals arise from a setting of otherworldly tones. Some are produced on reeds in all shapes and sizes — the largest looks like the antlers of a giant deer, spanning three meters. Particularly notable is a variety of extended percussion. PVC drainpipes fitted with cellophane drum heads provide clear pattering rhythm patterns. Drums come with long strings attached, that are amplified through clipped-on piezo pickups. Some lead to metal bowls, some also have heavy metal coil springs hanging from them. The strings add reverb and overtones to Berthet's drumming, but they can also be played autonomously by striking, bowing or stroking.

When I saw the two in concert, to my amazement these acoustic setups sounded as if they had been channeled through effects boxes or had undergone serious electronic filtering. At some points a curious buzzy melody developed, that I could not relate to any visible manipulation of instruments. It proved to be Berthet's vocal tract at work in the loudest bouts of overtone singing I have ever heard live.

Part two of the CD features two long installation pieces devised by Pierre Berthet. One highlights Berthet's work with water drops falling on drum heads. The other consists of a trumpet played with the bell in a flask which is connected to a barrel with steel wire; a second wire connects the barrel with a spring coil. The result is a wealth of fundamental and overtone resonances that make this delightful album end on an ambient note.

—RvP

ED MANN and BRIAN HAND: **GLOBAL WARMING**

CD available from Interworld Music, RD3 Box 395A, Brattleboro, VT, 05301

Global Warming is a gentle, yet vibrant percussion panorama played and created by longtime Frank Zappa percussionist Ed Mann, and percussionist Brian Hand. Here the listener visits mounds of bells, rattles, shakers, gongs, hand percussion, and vibes. Being nicely recorded, the disc provides smooth listening from beginning to end for the avid percussionist within and without.

The only original or experimental instruments here are the tuned pipes, air tubes or whirlies as they are commonly known, found objects and the beautiful three-chambered ocarina built by Sharon Rowell called *hauca*.

The 40 minute length of the CD seems to work quite well, centering on quality rather than quantity. Still, some works tend toward overexhaustive inclusion of instruments, like the pieces, "Rhythm Ocean," where seemingly dozens of textural and timbre changes occur over a constant conga, and "Vibes," a jazzy, African-influenced excursion.

The most evocative pieces to this reviewer are the two special pieces for Rowell's huaca and gongs. These meditative pieces really show off the brilliant yet dark presence of this instrument.

"Bell Garden" and "Thumbs up" are also worthy of mention, where windchime/glass bell-like sounds merge and flow while jawharps, mouth bows, and thumb piano thump and twang.

What all this has to do with global warming and the depletion of our ozone layer, I might never know. But this disc is an excellent excursion into the world's percussion in the hands of two quite able musicians.

—SB

BRIAN McLAREN: **MICROTONAL MUSIC, VOL. 1 - 4**

JEFF STAYTON: **FEAR OF OPEN SPACES**

JEFF STAYTON: **MICROTONAL MUSIC VOL. 2** and JONATHAN GLASIER: **THE XENHARMONIC MUSIC OF JONATHAN GLASIER**

VARIOUS ARTISTS: **NEW MICROTONAL MUSIC FROM SOUTHERN CALIFORNIA, VOL. 1-2**

VARIOUS ARTISTS: **MUSIC FROM THE EDGE, VOL. 1-2**

On cassette from Brian McLaren, 2462 S.E. Micah Place, Corvallis, OR 97333-1966-17

Over a period of twenty years and more, the San Diego area has been a surprisingly rich locus for microtonal music. An important part of the area's fertility has been a loose affiliation of people who have over the years been associated with the Interval Foundation, the Sonic Arts Gallery, and the early flowering of new microtonality that was *Interval Magazine* († ca 1986). This includes people like Jeff Stayton, Jonathan Glasier, Will Parsons, Erv Wilson, Bill Wesley, Jim Danielson, members of the ID Project, the late Ivor Darreg, and many others.

Brian McLaren has undertaken the task of archiving the recorded music of some of these musicians. He has now produced a series of cassette tapes — ten of them, at the time of this writing — of recent microtonal music from the San Diego area. (This doesn't include another series of tapes which Brian has produced archiving the extant recordings of Ivor Darreg.) The cassette series is a no-frills operation, with the tapes appearing in unadorned black-and-white packaging, but the sound quality is generally good, and the liner notes, while necessarily brief, are informative and well written.

Four of the cassettes, titled *Microtonal Music Volumes 1-4*, present Brian's own work. These are synthesizer works, primarily in orchestral timbres, many of them having something of the feeling of composed orchestral music. Between the four of them, these tapes contain pieces in every equal temperament between 5 and 53 tones per octave, as well as pieces in other tunings which are neither just nor equally spaced. With the current emphasis on just intonation in many musical circles, one effect of this great wealth of non-just microtonal pieces is to demonstrate a world of possibilities in non-just scales. Each of these pieces has a distinctive flavor associated with its tuning. If one doesn't grab you, the next one might; and some of the tunings turn out in Brian's hands to be — especially if you are willing to listen closely — utterly seductive. McLaren and the other participants in the cassette series do use just tunings as well, including extended harmonic series, and, more particularly, tunings devised by the Los Angeles area theorist Erv Wilson.

Next in the cassette series we have *Music from the Edge, Volumes 1 and 2*. These two tapes present recent recordings from various artists in the San Diego microtonal music arena, featuring both synthesized sounds and acoustic instruments, in both live and studio recordings. Here's a rundown of the artists appearing singly and in various combinations: Jeff Stayton plays megalyra, the big electroacoustic slide zither created by Ivor Darreg, the tone of which has aptly been compared to "tuned thunder." Will Parsons plays electronic drums. Bill Wesley plays his beautiful, justly-tuned array mbira (an mbira for which he has designed an unusual pitch-layout for the tines), and array guitar. Jonathan Glasier plays cello, and guitars refretted to produce various scales. Hirsch uses the natural harmonic resonances of large plastic tubing to modify his vocals. Brian McLaren plays sythesizers, as well as the big metal rod instrument called Godzilla. *Music from the Edge Volume 2* is devoted primarily to duets between McLaren and Glasier, with Bill Wesley's mbira appearing on two tracks. Volume 1 features Jeff Stayton and Will Parsons more prominently. Both of volumes contain live, improvised music with highly varied instrumentation, and the exploratory quality is ever-present.

New Microtonal Music from Southern California, Volumes 1 and 2 feature many of the same musicians, with some additions. Volume 1 presents Jeff Stayton on megalyra and synth, Brian McLaren on synthesizer, and Jim Danielson on shakuhachi. Volume 2 opens with several pieces by the same three, then continues with pieces featuring McLaren with Jonathan Glasier and later Bill Wesley. It is on this tape that we

hear the greatest variety of unusual acoustic instruments, including Godzilla (the metal rod instrument mentioned earlier), wing (a wing-shaped sheet of stainless steel, with long metal prongs attached, resting on balloons, played by percussion or friction), waterphone, megalyra, and array mbira, plus a psaltery and hand drums.

Finally we have two cassettes representing individual artists. *Fear of Open Spaces* is devoted to the music of Jeff Stayton in solos and duos with McLaren and Glasier. Stayton plays solos on electric and acoustic guitars refretted to 19 tone equal temperament (the acoustic improvisation strikes me as heavy-handed; the electric one, while perhaps overprocessed, is shimmeringly lovely). There is a duet for a metal bar set tuned to the unusual scale of 13-tone equal temperament by Ivor Darreg. And there are duets for employing synthesizers, computers and electric bass. The second side of this cassette is a continuation of the McLaren cassette series discussed above, comprising Volume 4 of that series.

A second cassette titled *Stayton: Microtonal Music Volume 2 / The Xenharmonic Music of Jonathan Glasier* opens with a few more tracks of Jeff Stayton's music. Most of the remainder of this cassette is devoted to music of Jonathan Glasier. First we hear an improvisation on a truly remarkable harp, having seemingly a zillion strings, tuned to 100-tone equal temperament. With the string pitches so very close together, some extraordinary sliding-glissing effects become possible. This is followed by synthesizer duets with McLaren in diverse tunings, and finally duets using metallophones set to tunings by Erv Wilson. At the close of the cassette are two non-Glasier pieces, performed by Bill Wesley on array mbira. Even when played virtuosically, as it is here, Wesley's mbira has a simplicity and directness of sound and thought that is always good for the ears.

You can listen to these cassettes simply for the fact that, despite some inconsistency in quality, there are plenty of performances captured here that are worth the listening, in ways that are varied and refreshing. Or you can listen for the seemingly inexhaustable world of possible tunings presented. If you're in it for the tunings, you can approach them in an analytical sort of way, or in a purely experiential mode. Take your pick. There's a lot here.

—BH

ALESSANDRO MORESCHI:
THE LAST CASTRATO: COMPLETE VATICAN RECORDINGS

Opal CD 9823 (1984/1987). Available on CD in records stores (produced by Pavilion Records Ltd., Sparrows Green, Wadhurst, East Sussex, England).

Here it is: the one and only record of the one musical instrument that will never exist again. Some mysterious instruments of the past, such as the Greek *magadis* and English *chekker,* may defy attempts at definitive identification and accurate reconstruction, but this one, about which the mechanics are clearly known, is gone forever. We can, of course, be thankful of that, but we can also be thankful that these recordings of almost a century ago have survived.

Alessandro Moreschi (1858-1922) was one of the very last of the *castrati* — boys, in possession of fine singing voices, who were castrated for the purpose of retaining that voice as an adult. The vocal tradition of the castrati — which had flourished for some 250 years previous — was in its twilight when Moreschi was born. He had gone under the knife by the time he was twelve, when the Italian government banned the practice once and for all. The young Moreschi was among the last to be subjected to this mutilation, which would profit poverty-stricken parents and (although they would not acknowledge that such things were taking place) the Catholic Church: Moreschi became a singer in, and then also the conductor of, the Choir of the Sistine Chapel in the Vatican. Women were banned from singing in the cathedrals —"Let women be silent in churches," said St. Paul the Apostle. And if the angelic voices of boys could be maintained as the angelic voices of men while the Pope looked the other way, then sacred polyphonic music (calling for soprano parts too difficult for boy sopranos) could be performed *and* St. Paul the Apostle's tenacious dictum could continue to be exercised.

This collection includes Moreschi's complete recordings, made in April of 1902 and April of 1904. Besides giving a glimpse of the sound world of the castrati, the collection is of interest musicologically for the fact that it contains the last (and only?) recordings made by the Choir of the Sistine Chapel of the sort of harmonically lush, "secular" settings of sacred texts that were banned by Pope Pius X, in 1903, in favor of the restoration of Gregorian chant.

These recordings are among the most otherworldly documents of the early era of recorded sound. What makes these recordings unique is the startling strangeness of Moreschi's voice itself. It is a full-fledged soprano range, with a tone color unlike any style of soprano voice we will hear today. The castrato's voice had greater substance to its sound than that of a boy soprano or a falsetto, and when compared to a female soprano there is definitely a different sense of, well, *origin.* The singing style in these recordings is itself also an unfamiliar one, incorporating vocal techniques current when Moreschi was studying singing but which are not heard as part of modern singing technique (such as the use of grace notes — *acciaccatura* — of wide interval size, sometimes as large as a tenth, giving a "scooping" effect to the articulations of notes).

The CD's booklet contains two substantial essays, the first concerning the historical context of the recordings and the second giving a history of the castrati and an appraisal of Moreschi's singing. There is also a brief, interesting note on the question of determining the correct playing speed for these old gramophone recordings, indicative of the ways in which early phonographs and their techniques of recording and playback are clearly in the domain of musical instruments: this process of settling on a particular playback speed, so that the keys of all the pieces (each recorded on an individual one-sided disk) make sense, is much like bringing a stringed instrument into an appropriate tuning for performance.

As it turns out, the Gramophone Company, of England, which made these recordings, had gone to Rome in 1902 not with the idea of recording the singing voice of Moreschi but rather the speaking voice of Pope Leo XIII (then in his early 90s). That turned out not to be possible, and the Gramophone Company recorded the Choir of the Sistine Chapel (and Moreschi) instead. By the time the Gramophone Company returned in 1904, Leo XIII had died, and the company further recorded Moreschi and the choir. Altogether, the seventeen recordings consist of solos by Moreschi (with, usually, piano accompaniment), small vocal ensembles, and choral works in which Moreschi's voice is clearly discernible. As perhaps something of an after-the-fact attempt to fulfill the Gramophone Company's original intention, a 1903 cylinder recording of Leo XIII reciting the *Ave Maria,* made by Bettini, is included at the very end of this collection.

In *Farinelli,* a recent Belgian movie about an early operatic castrato, a process of digitally "morphing" a male voice and a female voice has been used to imitate the castrato's voice. Also, historically informed performances of early opera are coming to include performances by *sopranists,* male singers who (without going under the knife) have perfected singing in the soprano range. As interesting as these may be, *beware of imitations*!

Although these recordings offer at least a few clues to the brilliance of the sound of the castrato era, the tradition of the castrati is silenced forever. Silenced too is that special cry which would greet a castrato after a fine performance (and which sounds like it's in among the shouts of approval at the end of Moreschi's recording of Paolo Tosti's *Ideale*): *Eviva il coltello,* "Long live the knife!"

A further note: A couple of items which may be of interest as regards this early era of acoustic gramophone recording, contemporary to the Moreschi records, are *Emile Berliner's GRAMOPHONE: The Earliest Discs 1888-1901* (Symposium 1058), which covers the earliest gramophone recordings made by Berliner through the rise of recorded opera, and *Enrico Caruso: Opera Arias and Songs* (EMI CDH 7610462), which features Caruso's first recordings, made in Milan by the Gramophone Company a week after they had recorded Moreschi.

—MC

RAMBLINGS

From Bart Hopkin, EMI's editor

Today's topic: making things echoey.

One way to make the sound of an instrument fuller or more lush is to enrich it with reverberation. Contemporary sound recording and reinforcement engineers do this routinely to most of the sounds that pass through their mixing boards. What they add is electronic reverb — a digitally re-processed lingering wash of the original sound signal, which mixes in and can be heard fading more slowly after the original sound is gone.

Sound engineers sometimes overdo it with the artificial electronic stuff. But acoustic reverberation is a natural phenomenon, present to some degree in virtually all the sounds we hear. And it does, subjectively speaking, contribute to a sense of sonic richness.

For the purposes of this discussion we can define reverberation as the lingering of sound vibrations in media other than the original medium, after the vibration in the original medium has ceased. The most familiar example of this is room reverberation: a sound occurs in a room — let us say, someone shouts — and in so doing excites the air in the room into vibration. For a short time after the end of the shout, the air in the room remains active as sound waves continue to reflect off of the walls and other surfaces before dissipating. The ear hears the lingering vibration in the air as a sort of ghost of the original sound — an echo, or reverberation.

There are lots of other possible reverberant systems beyond room reverberation, and some of them can be built right into acoustic musical instruments. Most instruments, in fact, are inherently fairly reverberant to begin with. Consider the guitar: The original vibration source is the string. The soundboard is a secondary medium. While the soundboard is designed to reproduce the vibratory movement of the string with some fidelity, it does not cease vibrating the instant the string stops. It takes a moment to die down. The listener is scarcely aware of this as a distinct phenomenon, yet it does add to the fullness and complexity of the guitar sound. Another example: In a harp, the many strings tend to pick up vibrations from one another, ringing along with one another, and other strings often continue to sound even after the original vibrating string has ceased.

If a little reverb is nice, then how about a little more? What are the possibilities for introducing additional non-electronic reverberance to acoustic instruments?

The trick in doing this is to find some vibrating medium that will readily pick up the sound from the initial source of vibration and vibrate in sympathy at the same frequencies. Several materials do this reasonably well, and I'll review a few of them in the remainder of this article.

As the harp example above suggests, one of the old favorites is ...

STRINGS

Many instrument types, both western and eastern, employ extra strings designed not to be played in themselves, but intended only for sympathetic vibration. Sympathetic strings can work as an addition to idiophones of many sorts, as well as instruments whose primary vibrating elements are strings.

The most common approach has been to attach a relatively small number of extra strings to the body of the instrument, deliberately tuned for reverberation at specific pitches. This is done on the sitar, the European Viola d'Amour, and many others. Alternatively, you can attach a large number of strings which are not carefully tuned, under the assumption (justified by experience) that with enough randomly tuned strings, virtually any note you play will find a resonance in one or more of the strings. This latter approach is more work initially (more strings to be put on) and less work later (no careful tuning needed). It yields a very satisfying wash of reverberance, with particularly fine, well-defined high frequencies.

I built something based upon this principle that I was very happy with. Prongs and Echoes, as I call the thing, has a lot of strings, but the player doesn't play them (or at least not normally). Instead, the strings are there to pick up and reverberate vibrations from another primary sound source. For its primary vibrators I deliberately gave the P&E something with a very short, sharp, and abrupt sound envelope, namely: extremely short spring steel rods, mounted kalimba-style on a not-too-heavy soundboard. These short little prongs give a clearly pitched sound that happens and is gone immediately, leaving behind the lingering wash of reverberant strings. The instrument has two chromatic octaves worth of prongs, and 48 reverberant string segments of varying lengths. I've never bothered to tune the strings at all, and they do very nicely the job of echoing whatever note the prongs happen to produce.

Incidentally, people often use a piano with the dampers lifted for the same effect. Play an instrument or sing loudly near a piano with the damper pedal depressed, and you will hear the piano's sympathetic answer to each note.

SPRINGS

Coil springs make excellent reverberation devices, because a single spring can pick up and resonate a broad range of frequencies (in contrast to strings, which are quite specific in what frequencies they will resonate). This means that you can use one or two or three springs, without any special tuning, for reverberation over the entire sounding range. The tone quality is not as good as strings, though. Their frequency biases tend to make for a recognizably springy sound.

The ideal spring is a long, thin, lightweight coil spring. It can be attached to the sounding body much like a string, under light tension. Like sympathetic strings, the spring may also provide an additional sound source in its own right. I have found that old turntable drive springs are suitable for delicate sounds, while slightly heavier springs may be preferable for heavier sounds. Where to get such springs? The selection available at most hardware stores is somewhat limited. You can find a great variety

of springs as industrial surplus (my favorite industrial surplus outlet: American Science and Surplus — call (708) 982-0780 and ask for a catalog).

PLATES

Large, flexible pieces of sheet metal which are free to vibrate will add a generous wash of reverb if given the chance. François and Bernard Baschet, Tom Nunn and Robert Rutman, among others, have made instruments using large stainless steel sheets non-rigidly mounted, as the primary sound radiator. The sheets can be suspended by cords, or they can be supported on balloons, which leave them free for uninhibited vibration. Several types of instruments have been made this way, among them: string instruments; instruments with metal rods rigidly mounted to the sheets and played by bowing or percussion; and instruments in which the sheets themselves are played directly by bows or percussion. These things really give new meaning to the word 'reverberation.' The effect is more outrageous than subtle. Rigidly held metal sheets are less out-of-control, and, as a corollary, less reverberant.

"WHISKERS"

This is another approach the Baschet brothers explored, years ago. Attach many lengths of moderately heavy music wire to an instrument's sound board or other vibrating, radiating surface. Wire of about 1/32" diameter might be about right, and anywhere from a foot to several feet long. The wires should be firmly mounted at one end, and swaying and floppy at the other, yet able to support their own weight. These floppy rods will act a bit like sympathetic strings, picking up vibrations from other drivers, and then sustaining the vibrations even as they feed them back into the soundboard for radiation into the air. I have found the whiskers sound to be a bit heavy and thuddy; not as clear as strings — maybe I'm not using them properly. If you do make a set of whiskers, *be sure* to give the wire ends a generously curved, closed loop to prevent their stabbing anyone.

The methods and examples described here are most suitable for adding reverberation to stringed instruments and idiophones. That's because for strings and idiophones it's possible to attach reverberating devices directly to the vibrating bodies — either to the initial vibrators or to support structures and radiators. For wind instruments, the most promising approach might be for the player to play directly into resonant devices without actually touching them, as with the undamped piano strings mentioned earlier. Something like the large, lightweight metal plates described above, suspended or balloon-mounted, might also work nicely

Remember too that the most effective reverberant devices have always been the walk-in variety: the underground cave, the abandoned tunnel, the empty water-storage tank, the stairwell at the local high school where doo-woppers used to gather. Reverberant sound all around, with you inside.

...And there, readers, you have a few approaches to enhanced reverberation for acoustic instruments. Are there other approaches that I haven't thought to include here? Undoubtedly.

RECENT ARTICLES, continued from back cover

information on particular machines, and broad-based overview articles, as well as information on activities, membership and the like.

Woodwind Quarterly #10, August 1995 (1513 Old CC Rd., Colville, WA 99114 USA) contains , as always, a generous helping of articles on woodwind making, including —

"The Design of a 19th Century Flute Reproduction" by John Edfors: a systematic description of the conceptualizing and design process for a keyed wooden flute.

"Recorder Making at Moeck" by Luke Goembel: a report on a tour of the Moeck recorder factory in Celle, Germany.

"Diagnosing Woodwind Bores" by Jim Gebler: A practical approach to the subtle business of bore modification to improve intonation and playability in woodwinds.

"Bagpipe Makers Resource Guide" by Scott Hirsch: A listing of vendors carrying supplies relating to bagpipe making.

Recent Articles in Other Periodicals

The following is a list of selected articles relating to musical instruments which have appeared recently in other publications.

"Color-Music Fountains and Installations of the Erebuni Group" by Abram Alexandrovich Abramyan, in **Leonardo** Volume 28 #4, 1995 (MIT Press Journals, 55 Hayward St., Cambridge, MA 02142-9902, USA).

The Erebuni Group is a group of Armenian artists and engineers who have created a number of large-scale color-music fountains in public areas in Armenia and elsewhere in the former Soviet Union. In these fountains, changing water displays and variable colored lighting are co-ordinated with pre-recorded music.

"How to make a shelly hautbois" by David Z. Crookes, in **FoMRHI Quarterly** No. 80, July 1995 (c/o Faculty of Music, St. Aldate's, Oxford OX1 1DB, UK).

Brief but informative notes on making shell trumpets, including ideas on adding side holes for additional notes.

"Accordion Repair" by Brian Seehafer, in **TechniCom** Vol. 20 #4, July-August 1995 (PO Box 51, Normal, IL 61761).

A hands-on look at accordian innards, with notes on reed tuning as well as mechanical problems that may arise.

"A Sugar in the Gourd Banjo" by Ray Carnall, in **The Gourd** Volume 25 #3, Spring 1995 (PO Box 274, Mt. Gilead, OH 43338-0274).

The author describes how he made a banjo using a short-handle dipper gourd for the body. Photos included.

"Do-It-Yourself Pluckings" by Gordon Frazier, in **American Bamboo Society Newsletter** Volume 16 #1, February 1995 (PO Box 215, Slingerlands, NY 12159-0215).

This article, reprinted from issue #5 of *Pluck*, the jaw harp newsletter, describes in practical terms, with lots of hand-drawn illustrations, the making of a the Philippine bamboo jaw harp called *kumbing*, as taught to the author by instrument maker Ben Hume.

"Hammers, Cones and Tomes" by John Koster, in "The Shrine to Music Museum Newsletter" (414 E. Clark, Vermillion, SD 57069).

The conservator of instruments at the Shrine to Music Museum describes early tools used for tuning organs, pianos and harpsichords, with reference both to early written sources and to tools held in the museum.

"Tuning Pins and their Holes" by Hilliard Stone, in **Folk Harp Journal** #88, Summer 1995 (4718 Maychelle Dr., Anaheim CA 92807-3040 USA).

Notes on setting tuning pins in harps.

"Les Xylophones d'Afrique Subsaharienne" by Nathalie Fernando & Fabrice Marandola, in **Percussions** No. 40, May/June 1995 (18, rue Theodore-Rousseau, F-77930 Chailly-en-Bierre, France).

Notes (in French) on African xylophone forms.

"Questions a Selwyn Henri" by Emmanuel Masselot, also in **Percussions** No. 40, May/June 1995 (address above).

An interview (in French) with Trinidadian steel drum leader Selwyn Henri.

"Tickling the Web" by David Bullock, in **Dandemutande** 6, July 1995 (1711 Spruce St., Seattle, WA 98122-5728).

An overview of resources available on the internet for people interested in mbira and marimba music.

"The Well Tempered Scale, Part Two" by Stephen Golovnin, also in **Dandemutande** 6, July 1995 (1711 Spruce St., Seattle, WA 98122-5728).

Accoustic background leading to the author's exposition of marimba bar tuning procedures, which will be covered in the next article in this continuing series.

"The Development of Musical Glasses Prior to the 18th Century" by Lynn Drye, in **Glass Music World**, Summer-Fall 1995 (2503 Logan Dr., Loveland, CO 80538 USA).

This is the second installment in a multi-part article on water-tuned vessels. The focus in this part is on early European musical glasses.

"Rebirth of the Glass Harmonica" by Gerhard Finkenbeiner, also in **Glass Music World** Summer-Fall 1995 (address above).

In this second installment of a continuing article, the leading contemporary commercial maker of glass harmonicas looks back on the early days of his enterprise.

Journal of the American Musical Instrument Society Volume XXI 1995 (6114 Corbin Ave., Tarzana, CA 91356-1010) contains several articles on early pianos, plus these items among the reviews: a review of *Der Csakan und seine Musik* by Marianne Betz (a book on the csakan, which was one of several variations on the walking-stick flute fashionable in parts of 18th & 19th century European society), and a review of *Microsoft Musical Instruments* (a CD-ROM devoted to instruments of the world).

"Complex Whistles Found to Play Key Roles in Inca and Maya Life" by William J. Broad, in the *Science Times* section of **The New York Times** for Tuesday, March 29, 1988.

A report on the remarkable, multifaceted flutes and whistles of America before the Spanish conquest. The author discusses aspects of the social function of the instruments, as well as their construction and acoustics.

The British Harry Partch Society Newsletter (33 Arthur Road, Erdington, Birmingham, B24 9EX, England) is an organ of the newly formed British Harry Partch Society. Volume I #2, August 1995, contains reviews of available Partch recordings, notes on individuals active in preserving or recreating Partch's work, research into Partch's life, and information on the society.

The AMICA Bulletin (515 Scott St., Sandusky, OH 44870-3736) is the bi-monthly publication of the Automatic Musical Instrument Collectors' Association. When *EMI* recently sent in membership dues, we received several recent issues of the Bulletin brimming with more articles on early automatic instruments than we can note here. These include technical articles with highly specific

(Continued on page 43)